Spring Rise Plenary Group
4th Meeting on August 19, 2005
in Sioux Falls, SD

Flood Control Constraints

Purpose. Flood control constraints (FCC's) are used to limit releases to avoid exceeding target flows at the three locations of Omaha, Nebraska City, and Kansas City.

FCC Set. There are two sets of FCC's – one that applies to reduction to full service at Sioux City, Iowa, and a second that applies to reduction to minimum service at Sioux City.

Overview. FCC's are included in the Master Manual to provide a mechanism to reduce Gavins Point Dam releases to the Lower Missouri River when the potential for downstream flooding occurs. The U.S. Fish and Wildlife Service, after reviewing the data on the number of spring rises provided by the alternatives that the Corps of Engineers (Corps) has evaluated in response to a request by the Spring Rise Plenary Group at its 3rd meeting in Omaha, NE on July 26-28, 2005, determined that at least a minimum increase in the FCC's is required to provide an acceptable number of spring rises. This paper describes the FCC's and provides some clarification for the minimal increases. It then discusses the tradeoffs for the different increases in FCC's evaluated for the Plenary Group.

FCC's are defined as target flows at three Lower River locations – Omaha, NE, Nebraska City, NE, and Kansas City, MO. The first set of constraint target flows are established to reduce the releases from Gavins Point Dam to those required to provide full service to navigation at only Sioux City, IA (not necessarily at Omaha, Nebraska City, or Kansas City, the other three navigation target locations). The second set of constraint target flows are established to further reduce the Gavins Point Dam releases to provide minimum service at Sioux City when the flows at the target locations are somewhat higher than those for the first set of target flows. Table 1 presents the current flood control constraints in the Master Manual.

Table 1

FCC's in the Master Manual

	Flow Target for Service Level of 35 (Full Service)	Flow Target for Service Level of 29 (Min. Service)	Flood Control Target (Reduce to Full Service)	Flood Control Target (Reduce to Min. Service)
Sioux City	31	25		
Omaha	31	25	41	46
Nebraska City	37	31	47	57
Kansas City	41	35	71	101

Relationship between FCC's and Spring Rises. To allow an adequate number of spring rises to occur, the FCC's in Table 1 that reduce the Gavins Point Dam releases to provide no more than full service at Gavins Point Dam need to be "relaxed", or raised above those shown in the table. For example, the studies conducted for the 4th Plenary Group meeting show that no increase, or relaxation, of the constraints results in 47 first rises out of 107 years of analysis and 30 second rises. By relaxing these constraints, the number of first rises can be increased from 47 and from 59 to as many as 78, and the number of second rises from 30 and from 62 to as many as 81.

Corps has looked at various increases from "minimum" to as much as the amount of the spring rise magnitude being evaluated for either of the rises. Examples of the minimum changes in the FCC's are shown in Table 2.

Table 2

Minimum FCC's for the Lower River in kcfs

	Spring Rise = 16 kcfs		Difference from Current FCC	
Omaha	49	50	8	4
Nebraska City	55	57	8	0
Kansas City	75	93	4	(8)
	Spring Rise = 17 kcfs			
Omaha	50	51	9	5
Nebraska City	56	58	9	1
Kansas City	76	94	5	(7)
	Spring Rise = 20 kcfs			
Omaha	53	54	12	8
Nebraska City	59	61	12	4
Kansas City	79	97	8	(4)
	Spring Rise = 24 kcfs			
Omaha	57	58	16	12
Nebraska City	63	65	16	8
Kansas City	83	101	12	0

Potential effects of the relaxation – how many days will be affected in any year? Any day the "additional water" is added to the Missouri River, whether from a tributary or Gavins Point Dam, the risk of additional crop damages increases. Thus, the spring rise will increase crop-damage risk on the Lower River. This risk can be identified in many different ways, but Table 3 provides the average annual increase in the number of days that the flood stage minus X flow values for several Lower River stations identified by a Lower River group at the Third Plenary Session on July 26-28, 2005 in Omaha for three sets of changes to the flood control constraints. Table 3 also presents the current average annual risk values (# of days) under the new Water Control Plan implemented in 2004 (NWCP) and the number of spring rises in parentheses in the "amount of change" column. One way to look at the increased risk to crop damages is to look at the change from each level to the FCC's. When these values are compared to the relative increase in the number of spring rises (first and second), the tradeoffs of each level of flood control constraint change, or relaxation, can be evaluated. For example, an increase from no change to the minimum increase in the FCC's results in an additional 0.4 days of exceeding the "no change" number of days in March and April that exceed 47 kcfs at Nebraska City. This change results in an increase of 29 first rises. Similarly, the minimum increase in the FCC's increases the days of crop damage risk by 3.1 days in May and June and the number of second rises increases by 32. Going from the minimum increases to full increases in FCC's increases the number of days for first and second rise months by an additional 0.1 and 0.3 days, respectively, while adding 5 and 14 more spring rises, respectively.

Table 3

Average Annual Number of Days that the Flood Stage minus X Flow is Exceeded at Lower River Locations Relative to the New Water Control Plan for Three FCC Changes

	Gage Locations with FS-X Flows for Each Location				
Amount of Change	NC-47 kcfs	SJ–55 kcfs	KC-66 kcfs	BN-86 kcfs	HM-110 kcfs
First Rise					
NWCP Value	11.7	11.0	13.6	12.8	15.4
No change (47)	1.8	1.2	0.2	-0.1	-0.1
Minimum Increase (76)	2.2	1.6	0.4	0.1	-0.1
Full Increase (81)	2.3	1.8	0.5	0.1	0
Second Rise					
NWCP Value	23.2	22.4	24.6	20.3	22.4
No change (30)	3.5	2.3	1.5	1.1	0.4
Minimum Increase (62)	6.6	3.9	2.3	1.3	0.8
Full Increase (76)	6.9	4.6	2.4	1.6	0.9

Table 4 presents similar data for the number of days that the flood stage is exceeded. Again, the corresponding flows used in the analysis are shown in the column headings for each site evaluated. For example, this table shows that to increase the number of first and second spring rises from 47 and 30, respectively, to 72 and 62, respectively, the increase in the number of days the flood stage at Nebraska City is exceeded does not change (0.7 days more than under the NWCP for both the no change and minimum increase options). To further increase the number of first and second rises to 81 and 76, respectively, no further increase in the average annual number of days the flood stage is exceeded is identified.

Table 4

Average Annual Number of Days that the Flood Stage is Exceeded at Lower River Locations Relative to the New Water Control Plan for Three FCC Changes

	Gage Locations with Flood Stage Flows for Each Location				
Amount of Change	NC-83 kcfs	SJ–89 kcfs	KC-200 kcfs	BN-158 kcfs	HM-192 kcfs
NWCP Value	3.3	5.9	1.0	6.4	9.5
No change (47, 30)	0.7	1.1	0.1	0.3	0.3
Minimum Increase (76, 62)	0.7	1.2	0.1	0.4	0.3
Full Increase (81, 76)	0.7	1.2	0.1	0.4	0.3

FCC changes on System storage. FCC changes affect the minimum Missouri River Mainstem Reservoir System (System) storage levels identified from the hydrologic modeling conducted by the Corps. The values for the three FCC changes are presented in Table 5. The table also includes the number of first and second rises in order in parentheses in the first column. The Corps focuses on relative differences, as was the case in the discussion above due to hydrologic modeling limitations as the alternatives were modeled (also the case in the environmental impact statements prepared by the Corps for the Master Manual). The tradeoffs in minimum System storage are a loss of 0.49 MAF of storage to provide the minimum increase in the FCC's. This loss is increased by another 0.18 MAF (total of 0.67 MAF) to provide the full increase in the FCC's. The first loss provides an increase of 29 first rises and 32 second rises. The second storage loss provides an additional increase of 5 and 14 rises, respectively. To better understand the lake level effects, 1 foot in each of the three upper reservoirs at the storage levels at the times the minimum values occur is equivalent to about 0.6 MAF. The minimum increase would, therefore, result in a lower minimum level of about 10 inches in each of the largest three reservoirs and the full increase would result in a lower minimum level of about 1 foot in all three, when compared to the NWCP without the spring rises.

Table 5

Minimum System Storage Changes in MAF for Changes in the Spring Rise FCC's

Amount of Change	Droughts during the Period of Analysis (1898-2004)			
	30's	50's	80's	00's
NWCP Value	26.65	42.06	42.10	36.90
No change (47, 30)	0.39	0.11	0.13	0.34
Minimum Increase (76, 62)	-0.10	-0.18	-0.41	-0.06
Full Increase (81, 76)	-0.28	-0.25	-0.52	-0.13

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Drought Precludes

<u>Purpose</u>. A drought preclude for the spring rises will impact the frequency of the spring rise operation. The Plenary identified drought preclude options of 31, 40, and 49 MAF. Options and impacts are explored.

<u>Overview.</u> A drought preclude for the spring rises would be the Missouri River Mainstem Reservoir System (System) storage level during droughts below which a spring rise would not occur, or be precluded. To date, the Spring Rise Plenary Group has suggested the use of the March 1 value to determine whether the first spring rise would be precluded that year and the May 1 value for the second spring rise. The U.S. Fish and Wildlife Service (USFWS), upon review of the number of spring rises provided for the three preclude levels discussed at the 3rd Plenary Group meeting in Omaha, NE on July 26-28, 2005, has determined that a drought preclude of no higher than 40 million acre-feet (MAF) is required. Also, to increase the likelihood that a spring rise will occur in 2006, the USFWS also determined that a drought preclude of 36.5 MAF be used in 2006 if a higher preclude is recommended by the Plenary Group for a long-term plan, which is subject to change under adaptive management in the future as data are acquired and evaluated.

<u>Corps Modeling of Drought Precludes.</u> Drought precludes of 31, 40, and 49 MAF were identified at the 3rd Plenary Group meeting; therefore, the Corps of Engineers (Corps) modeled all three with one of the hydrographs selected for modeling. These three levels of storage drought precludes affect System storage and Lower River crop damage risk.

<u>Relationship between Drought Precludes and Minimum System Storage.</u>
Minimum System storage data for the four major droughts for these three levels are listed in Table 1 for the full increase in flood control constraints option for the Hydro – Multi Use (HMU) modeling runs. The data for the minimum increase option for the flood control constraints could also have been used with similar conclusions. This table provides the values for minimum System storage for the four droughts in the period of analysis and the relative changes from those levels for each of the three drought-preclude options. Also provided in the table are the number of spring rises (first and second, respectively) in parentheses after the preclude option values. There is essentially no difference in the number of spring rises for the 31- and 40-MAF options because the 31-MAF storage level would occur in a drought like the one that occurred in the 30's (1930 to 1941) drought. Similarly, there is only a change in the 30's drought data for the change from 31 to 40 MAF. In this drought, an additional 0.20 MAF of storage would be required to provide the spring rise if the 31-MAF option were provided instead of the higher 40 MAF. If the preclude were raised from 40 to 49 MAF, the minimum levels in all four droughts would be affected. The

minimum levels would be from 0.26 to 0.48 MAF higher, with the reservoir storage volume during the 00's (2000 to 2004 modeled) drought being affected the most. This range amounts to from less than 6 inches if the gain is distributed among all three upper reservoirs to about 10 inches for the increase in the drought preclude from 31 to 40 MAF and 40 to 49 MAF, respectively.

Table 1

Minimum System Storage Changes in MAF for Changes in the Drought Precludes
(full increase in flood control constraint option)

Preclude Option	Droughts during the Period of Analysis (1898-2004)			
	30's	50's	80's	00's
NWCP Value	26.65	42.06	42.10	36.90
31 MAF (81, 76)	-0.28	-0.25	-0.52	-0.13
40 MAF (79, 78)	-0.06	-0.25	-0.52	-0.13
49 MAF (62, 59)	+0.20	+0.18	-0.10	+0.35

Relationship between Drought Precludes and Lower River Damage Risk. Table 2 presents the data on the changes in the number of days that the flood stage minus X feet flow values are exceeded. Basically, this table shows that the greatest changes occur for the Nebraska City location, and the changes for the other four locations varies for no change to an increase of 0.2 days. The changes at Nebraska City are a maximum increase of 0.3 days for the first rise and a decrease of 0.6 days across the range of drought preclude options.

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Overview of Modeled Alternatives

Purpose. Modeling simulations of spring rise alternatives were requested by the Plenary at the July 26 – 28 meeting. Summaries of the ten modeling simulations are presented.

Overview. At its 3rd meeting in Omaha, NE on July 26 - 28, 2005, the Spring Rise Plenary Group requested that the Corps of Engineers (Corps) provide the plenary Group with data on an array of spring rise alternatives. The Plenary Group planned to use these data at its 4th meeting in Sioux Falls, SD on August 19 as it works towards presentation of its recommendation for a spring rise to the Corps and the U.S. Fish and Wildlife Service (USFWS). After the 3rd Plenary Group meeting, the Corps and USFWS selected three hydrographs on which to base this modeling and data gathering effort. These were the Pallid Sturgeon/Fish and Wildlife Working Group's 25 percent of the reference hydrograph proposal (R25 modeling series by the Corps), the Hydrology/Modeling Working Group's Multiple Use Alternative (HMU series), and the Socio-Economic Working Group's Spring Rise Proposal (SEC series). Descriptions of the hydrographs for these series and the changes to the hydrographs in response to drought conditions are outlined in written descriptions provided to the Plenary Group at its 3rd meeting. This paper provides an overview of the ten modeling simulations conducted on these three series.

Pallid Sturgeon / Fish and Wildlife Working Group's 25 Percent of the Reference Hydrograph Proposal (R25). Two model runs were completed on the R25 series. This series basically had a fast-rising bimodal spring rise with a magnitude of 18 thousand cubic feet per second (kcfs) above the winter service level for the first rise and 24.2 kcfs above the service level specified by Master Manual criteria for the mid-May time period. The peak release was held for 2 days before falling to the service level specified by the Master Manual. The fall side of the first rise dropped at a constant rate to the service level specified by the Master Manual for the subsequent period. A "kinked" fall from the second spring rise was specified where the rate of fall would be high for the first 2 days followed by a much slower decline until the release for the appropriate service level was reached. No prorationing of either spring rise was specified, with the drought preclude being 31 million acre-feet (MAF) on March 1. This series would use about 0.9 MAF if no factors affected the release rate during the full period of the two rises. The Corps made two modeling simulations, or runs. The first run was made with a full increase in the current Master Manual flood control constraints equal to the full magnitude of each rise. The second run was made with the "minimum" increase in the flood control constraints. These two runs were labeled as R25000 and R250F3, respectively.

Hydrology/Modeling Working Group's Multiple Use Alternative (HMU). Seven modeling runs were completed on the HMU series. This series had a fast-rising bimodal spring rise with a magnitude of 17 kcfs above the winter service level for the first rise and 20 kcfs above the service level specified by the Master Manual for the mid-May time period. The peak release was to be held for 2 days before falling to the service level specified by the Master Manual. Both rises were kinked on the fall side, with a fast drop for 2 days followed by a much lower fall rate to the appropriate service level release rate. Both rises were prorated from the maximum rate at 54.5 MAF of Missouri River Mainstem Reservoir System storage down to a minimum value (6 and 10 kcfs for the first and second rise, respectively) at a 31-MAF drought preclude value. Three drought precludes were modeled in this series – 31, 40, and 49 MAF. For the runs with the higher drought precludes, the prorationing was truncated at the value for that run. Two sets of flood control constraints were modeled – the full increase and a minimal increase. The naming convention was based on HMU000 for the base run with a 31-MAF drought preclude and the full increase in the flood control constraints. HMU040 and HMU049 were the identifying names for the corresponding runs with the full increase in the flood control constraints and a 40- and 49-MAF drought preclude, respectively. HMU0F3, HMU403, and HMU493 were the identifying names for the corresponding three runs with the minimum flood control constraints. Finally, a seventh run, which was labeled as HMU0F0, was made with no increase in the flood control constraints and the 31-MAF drought preclude.

Socio-Economic Working Group's Spring Rise Proposal (SEC). A single run was made for the SEC series. This run had a bimodal spring rise with the first rise having a magnitude of 17 MAF and the second rise having a magnitude of 24 MAF. The rise and fall rates were specified to be faster than those for the other two series. The first rise did not have a kinked fall rate, but the second rise had a kinked fall rate; however, the initial fall rate for the second rise was faster than the other two series. Minimum service was specified for the period between the two rises. Both rises were prorated from the maximum rate at 54.5 MAF of Missouri River Mainstem Reservoir System storage down to a minimum value (6 and 10 kcfs for the first and second rise, respectively) at a 31-MAF drought preclude value. The prorationing would have been truncated at higher preclude values than 31 MAF had higher drought precludes been modeled; however, only the 31-MAF option was modeled. It was modeled with a full increase in the flood control constraints equal to the magnitude of each spring rise. For modeling and evaluation purposes, this run was labeled SEC000.

Tabulated Summary. Table 1 summarizes the ten alternatives.

Table 1

Summary of the Ten Alternatives Modeled by the Corps

Alternative Name	Rise Magnitude (kcfs) First	Rise Magnitude (kcfs) Second	Drought Preclude (MAF)	Flood Control Constraint Change	Proration Range (kcfs)
R25000	18	24.2	31	Full	None Both
R250F3	18	24.2	31	Minimum	None Both
HMU000	17	20	31	Full	17-6, 20-10
HMU040	17	20	40	Full	17-12.1, 20-13.8
HMU049	17	20	49	Full	None, 20-17.7,
HMU0F3	17	20	31	Minimum	17-6, 20-10
HMU403	17	20	40	Minimum	17-12.1, 20-13.8
HMU493	17	20	49	Minimum	None, 20-17.7,
HMU0F0	17	20	31	Full	17-6, 20-10
SEC000	17	24	31	None	17-6, 20-10

Impacts of Spring Rise Components

Changes from the CWCP where Appropriate

Hydrograph/ lternative Run Name	Component Combination	Flood Control Constraints for Cutbacks to Full Service (kcfs)			Volume of Spring Rise (MAF)			# of SR's	# of Days Exceeding Specified Flow During Rises (M-A & M-J, 1898-1997)					# of Days Exceeding Flood Stage in April-June					Minimum System Storage (MAF)				USGS Spring Rise Dat		
		Omaha	Neb. City	Kan. City	1st Rise	2nd Rise	Total	in 107 yrs.	NC-47kcfs	SJ-55 kcfs	KC-66 kcfs	BN-86 kcfs	HM-110 kcfs	NC-83	SJ-89	KC-200	BN-158	HM-192	30's	50's	80's	00's	Median RDP	Median Duration	# SR > 10th % of Ref
	Magnitude, Proration, Preclude								March-April														1st Rise		
Current Water Control Plan		41	47	71	N/A	N/A	N/A		11.7	11.0	13.6	12.8	15.4	3.3	5.9	1.0	6.4	9.5	26.65	42.06	42.10	36.90	10.3	20.0	0.60
									May-June														2nd Rise		
									23.2	22.4	24.6	20.3	22.4										8.3	21.5	0.34
Hydro-Multi Use					0.15	0.27	0.42																		
	First Rise with **Full Inc in FCC**																								
HMU000	17 kcfs, **17 to 6, 31 MAF**	58 (+17)	64 (+17)	88 (+17)				81	2.3	1.8	0.5	0.1	0	0.7	1.2	0.1	0.4	0.3	-0.26	-0.25	-0.52	-0.13	4.3	-5.0	0.11
HMU040	17 kcfs, **17 to12.13, 40 MAF**	58 (+17)	64 (+17)	88 (+17)				79	2.3	1.8	0.5	0.1	0	0.7	1.2	0.1	0.4	0.3	-0.06	-0.25	-0.52	-0.13	4.3	-5.0	0.10
HMU049	17 kcfs, **17, 49 MAF**	58 (+17)	64 (+17)	88 (+17)				62	2.6	1.9	0.5	0.1	0	0.7	1.2	0.1	0.4	0.3	0.20	0.18	-0.10	0.35	4.3	-4.0	0.10
	Second Rise with **Full Inc in FCC**																								
HMU000	20 kcfs, **20 to 10, 31 MAF**	61 (+20)	67 (+20)	91 (+20)				76	6.9	4.6	2.4	1.6	0.9										8.5	6.5	0.58
HMU040	20 kcfs, **20 to 13.83, 40 MAF**	61 (+20)	67 (+20)	91 (+20)				78	6.8	4.6	2.3	1.6	0.9										8.4	6.5	0.56
HMU049	20 kcfs, **20 to 17.66, 49 MAF**	61 (+20)	67 (+20)	91 (+20)				59	6.3	4.4	2.3	1.5	0.8										7.5	6.5	0.48
	First Rise with **Min Inc in FCC**																								
HMU0F3	17 kcfs, **17 to 6, 31 MAF**	50 (+9)	56 (+9)	76 (+5)				76	2.2	1.6	0.4	0.1	-0.1	0.7	1.2	0.1	0.4	0.3	-0.10	-0.18	-0.41	-0.06	5.4	0.0	0.07
HMU403	17 kcfs, **17 to 12.13, 40 MAF**	50 (+9)	56 (+9)	76 (+5)				78	2.3	1.6	0.4	0.1	-0.1	0.7	1.2	0.1	0.4	0.3	0.05	-0.18	-0.40	-0.06	2.0	-7.8	0.07
HMU493	17 kcfs, **17, 49 MAF**	50 (+9)	56 (+9)	76 (+5)				59	2.3	1.7	0.4	0.1	-0.1	0.7	1.3	0.1	0.4	0.4	0.25	0.20	-0.07	0.38	2.2	-3.5	0.06
	Second Rise with **Min Inc in FCC**																								
HMU0F3	20 kcfs, **20 to 10, 31 MAF**	53 (+12)	59 (+12)	79 (+8)				62	6.6	3.9	2.3	1.3	0.8										10.5	9.0	0.41
HMU403	20 kcfs, **20 to 13.83, 40 MAF**	53 (+12)	59 (+12)	79 (+8)				66	6.5	3.9	2.2	1.3	0.8										6.9	6.5	0.41
HMU493	20 kcfs, **20 to 17.66, 49 MAF**	53 (+12)	59 (+12)	79 (+8)				48	6.3	3.8	2.2	1.2	0.7										4.2	6.5	0.40
HMU0F0	First Rise with **No Inc in FCC**	41 (+0)	47 (+0)	71 (+0)				47	1.8	1.2	0.2	-0.1	-0.1	0.7	1.1	0.1	0.3	0.3	0.39	0.11	0.13	0.34	0.2	-2.0	-0.07
	17 kcfs, **17 to 6, 31 MAF**																								
HMU0F0	Second Rise with **No Inc. in FCC**	41 (+0)	47 (+0)	71 (+0)				30	3.5	2.3	1.5	1.1	0.4										3.3	8.5	0.21
	20 kcfs, **20 to 10, 31 MAF**																								
25% of Reference Hydrograph						0.23	0.74																		
	First Rise with **Full Inc in FCC**	59 (+18)	65 (+18)	89 (=18)				81	2.1	2.1	0.1	-0.2	0.3	0.5	1.1	0.1	0.3	0.3	-0.99	-1.02	-0.92	-0.65	5.6	0.0	0.34
R25000	18 kcfs, **No proration, 31 MAF**																								
	Second Rise with **Full Inc in FCC**	65 (+24)	71 (+24)	95 (+24)				78	6.3	4.1	2.1	1.5	0.9										12.1	9.5	0.68
R25000	24.2 kcfs, **No proration, 31 MAF**																								
	First Rise with **Min Inc in FCC**	51 (+10)	57 (+10)	77 (+6)				81	2.1	2.2	0.1	-0.2	0.4	0.5	1.1	0.1	0.4	0.3	-1.05	-0.84	-0.79	-0.52	5.4	0.0	0.35
R250F3	18 kcfs, **No proration, 31 MAF**																								
	Second Rise with **Min Inc in FCC**	57 (+16)	63 (+16)	83 (+8)				64	6.0	3.2	1.6	1.0	0.7										10.5	9.0	0.65
R250F3	24.2 kcfs, **No proration, 31 MAF**																								
Socio-Economic						0.13	0.27																		
	First Rise with **Min Inc in FCC**	50 (+9)	56 (+9)	76 (+5)				79	2.4	1.7	0.4	-0.1	0.1	0.7	1.4	0.1	0.5	0.4	-0.08	-0.27	-0.32	-0.04	6.5	-2.5	0.37
SEC000	17 kcfs, **17 to 6, 31 MAF**																								
	Second Rise with Min Inc in FCC	57 (+16)	63 (+16)	83 (+12)				73	5.2	3.1	1.8	1.3	0.6										9.6	4.5	0.81
SEC000	24 kcfs, **24 to 10, 31 MAF**																								

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Hydrograph/ Iternative Run Name	Component Combination	# SR > 25th % of Ref
	Magnitude, Proration, Preclude	
Current Water Control Plan		0.14
		0.11
Hydro-Multi Use		
	First Rise with **Full Inc in FCC**	
HMU000	17 kcfs, **17 to 6, 31 MAF**	0.11
HMU040	17 kcfs, **17 to12.13, 40 MAF**	0.11
HMU049	17 kcfs, **17, 49 MAF**	0.11
	Second Rise with **Full Inc in FCC**	
HMU000	20 kcfs, **20 to 10, 31 MAF**	0.11
HMU040	20 kcfs, **20 to 13.83, 40 MAF**	0.11
	.	
HMU049	20 kcfs, **20 to 17.66, 49 MAF**	0.10
	First Rise with **Min Inc in FCC**	
HMU0F3	17 kcfs, **17 to 6, 31 MAF**	0.07
HMU403	17 kcfs, **17 to 12.13, 40 MAF**	0.06
HMU493	17 kcfs, **17, 49 MAF**	0.07
	Second Rise with **Min Inc in FCC**	
HMU0F3	20 kcfs, **20 to 10, 31 MAF**	0.12
HMU403	20 kcfs, **20 to 13.83, 40 MAF**	0.10
	.	
HMU493	20 kcfs, **20 to 17.66, 49 MAF**	0.08
HMU0F0	First Rise with **No Inc in FCC**	0.05
	17 kcfs, **17 to 6, 31 MAF**	
HMU0F0	Second Rise with **No Inc. in FCC**	0.08
	20 kcfs, **20 to 10, 31 MAF**	
25% of Reference Hydrograph		
	First Rise with **Full Inc in FCC**	0.14
R25000	18 kcfs, **No proration, 31 MAF**	
	Second Rise with **Full Inc in FCC**	0.21
R25000	24.2 kcfs, **No proration, 31 MAF**	
	First Rise with **Min Inc in FCC**	0.15
R250F3	18 kcfs, **No proration, 31 MAF**	
	Second Rise with **Min Inc in FCC**	0.06
R250F3	24.2 kcfs, **No proration, 31 MAF**	
Socio-Economic		
	First Rise with **Min Inc in FCC**	0.18
SEC000	17 kcfs, **17 to 6, 31 MAF**	
	Second Rise with Min Inc in FCC	0.27
SEC000	24 kcfs, **24 to 10, 31 MAF**	

A Simple Trade-Off Analysis of Flow Scenarios - DRAFT

Robert B. Jacobson, USGS, 8/16/2005

Introduction

The objective of this analysis is to evaluate the tradeoffs between adverse effects (costs) and presumed benefits of flow alternatives. Measures of costs include percent of days during which interior drainage is potentially impeded, percent of days during which flood stage is exceeded, and the effects of flows on total storage in the system. Benefits are measured as parts of the hydrograph considered to support life-history requirements of the pallid sturgeon. These include the size of spring pulses and numbers of pulses.

A standard method of trade-off analysis is to graph measures of costs and benefits on x and y axes (fig. 1). This is a simplified example of multiobjective systems analysis, using only two variables at a time and foregoing optimization. If costs are plotted in reverse order, the result is to plot value (negative cost) against value (benefit). A scatter plot of values attained from different flow scenarios illustrates how gains in one value are traded off against losses of the other. Clearly, trade-off curves in which one value declines modestly as the other is increased are desirable and reflect a relatively easy trade-off (convex up). Trade-off curves in which a value diminishes sharply as the other is increased reflect a hard trade-off situation (concave up). The magnitude of the trade-off depends on the shape of the trade-off curve and the units with which values are measured. For example, the societal value of additional days of flow above flap-gate elevations should be assessed in the same units as the societal value of additional cubic feet per second of late peak discharge; unfortunately, the translation to common units is not generally possible, so the analysis is limited to understanding relative sensitivity of values.

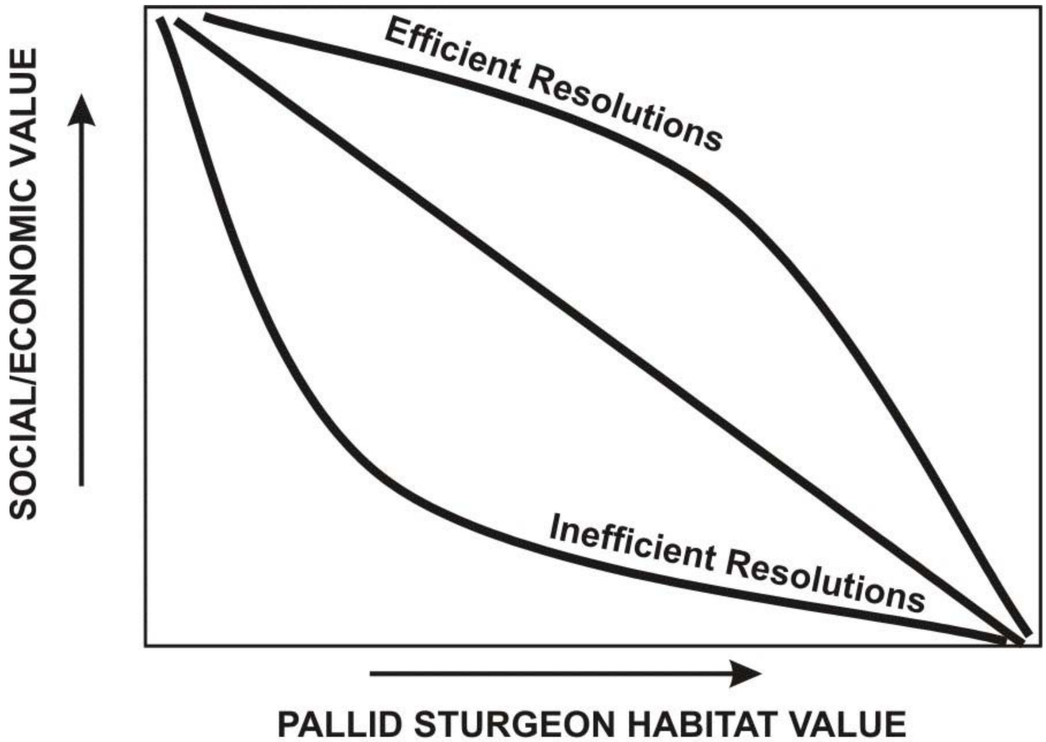

Figure 1. Conceptual trade-offs between two values.

Assumptions

This type of analysis assumes that alternatives selected as part of the analysis are the most efficient, and push the trade-off to its limits. Although many alternatives have been assessed, it is possible that other tradeoff solutions exist. The analysis also assumes that the variables extracted from the daily routing model (DRM) simulations are reasonably accurate portrayals of system performance. Because the DRM provides a statistical view of system performance based on the hydroclimatic variability inherent in over 100 years of record, it is assumed to provide a useful analysis of the average or median condition. It does not, however, provide a focused prediction of system performance expected in any given year. DRM results of “representative” years may provide some insight into behavior during specific hydroclimatic conditions.

Many different variables could be selected to evaluate costs and benefits. The variables shown here were chosen because they were calculated as part of the analysis process. They are believed to be indicative of relative performance but they are not necessarily optimal variables.

While flow alternatives are imposed in terms of discharges at Gavins Point dam, evaluation of costs and benefits is measured at other places along the river (fig. 2). Because elements of natural variability of the hydrograph (including spring pulses) increases downstream of the Platte River, Sioux City (SUX) was selected as the primary site for evaluation of benefits of the spring rise from Gavins Point Dam. Spring rises evaluated at Sioux City include aspects that are imposed at Gavins Point and some additional variability added by flows from tributaries between Gavins Point and Sioux City. Costs are evaluated at sites of concern downstream, with emphasis on flows that may impede interior drainage at Nebraska City, Nebraska (NCNE) and flows that may surpass flood stage at St. Joseph, Missouri (STJO) and Boonville, Missouri (BNV). Costs are also evaluated in terms of total system storage in the five mainstem reservoirs.

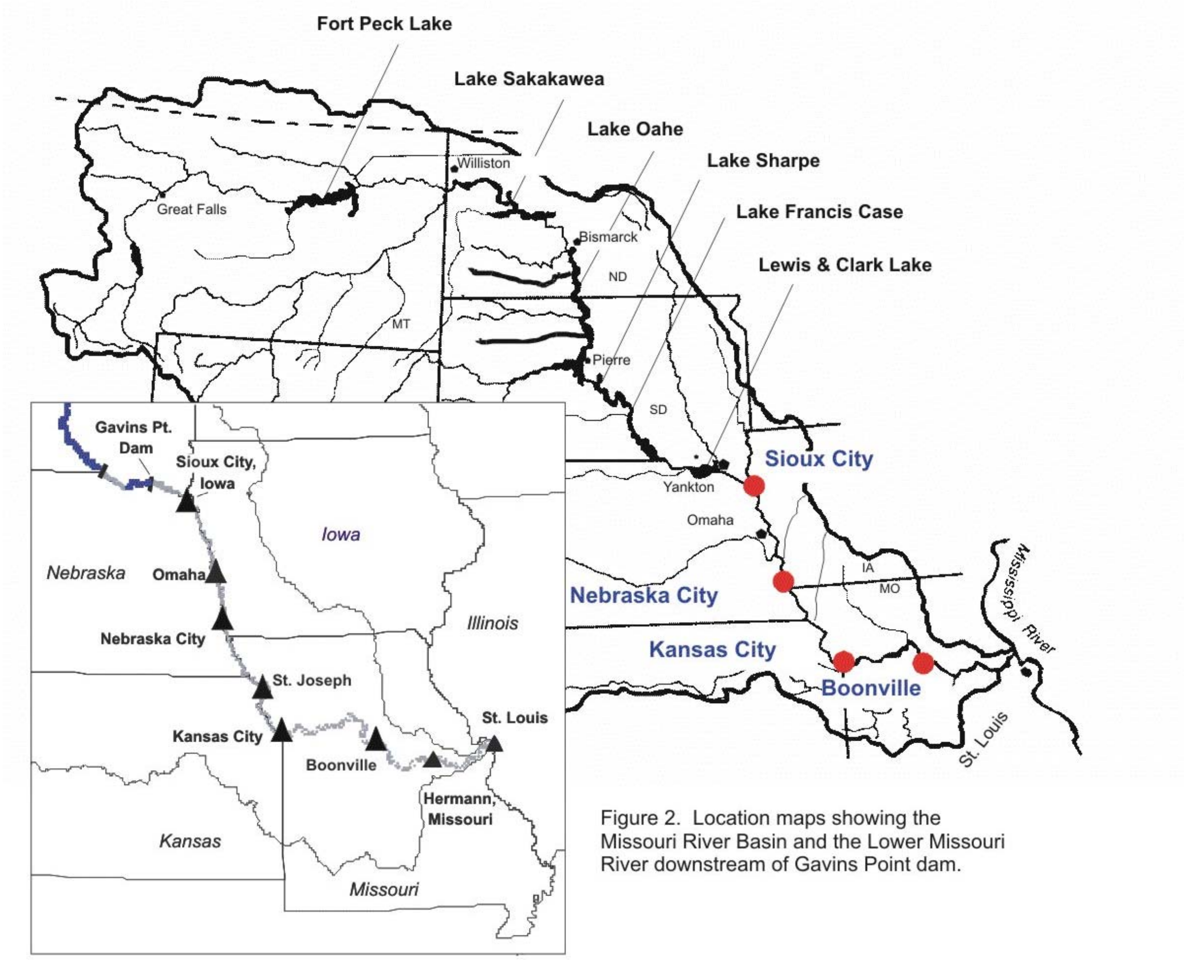

Figure 2. Location maps showing the Missouri River Basin and the Lower Missouri River downstream of Gavins Point dam.

Trade-offs among Plenary Alternatives

All Alternatives

Trade-offs between percent days with flows greater than 47 kcfs at Nebraska City and median relative peak discharges of the early and late rise are shown in figure 3. 47 kcfs at Nebraska City is the present (Master Manual) flow target which, if surpassed, would cause releases to be cut back to full service. Relatively small changes in peak discharge occur with relatively large increases in percent days > 47 kcfs moving from the current water control plan (NWCP00) to the multiple use with flap-gate flood control constraints (HUM0F0) and on to the clump of all other alternatives. Percent days with flows > 47 kcfs is relatively insensitive to increasing relative peak discharge at peaks greater than 12 kcfs.

Another measure of potential impedance of interior drainage is 55 kcfs at Nebraska City, a value that has been traditionally used by the Corps as a "rule of thumb" for interior drainage problems in that area. Figure 4 shows percent days exceeding 55 kcfs at Nebraska City and relative peak discharge of the late peak for comparison with the 47 kcfs criteria. The shape of the trade-off curve is similar, with the percentage of days exceeding decreased because of the higher discharge criterion. Relative performance of alternatives can be evaluated by using either target; however understanding of *acceptable* values would require an understanding of actual costs (or acreage flooded) associated with the discharges used here.

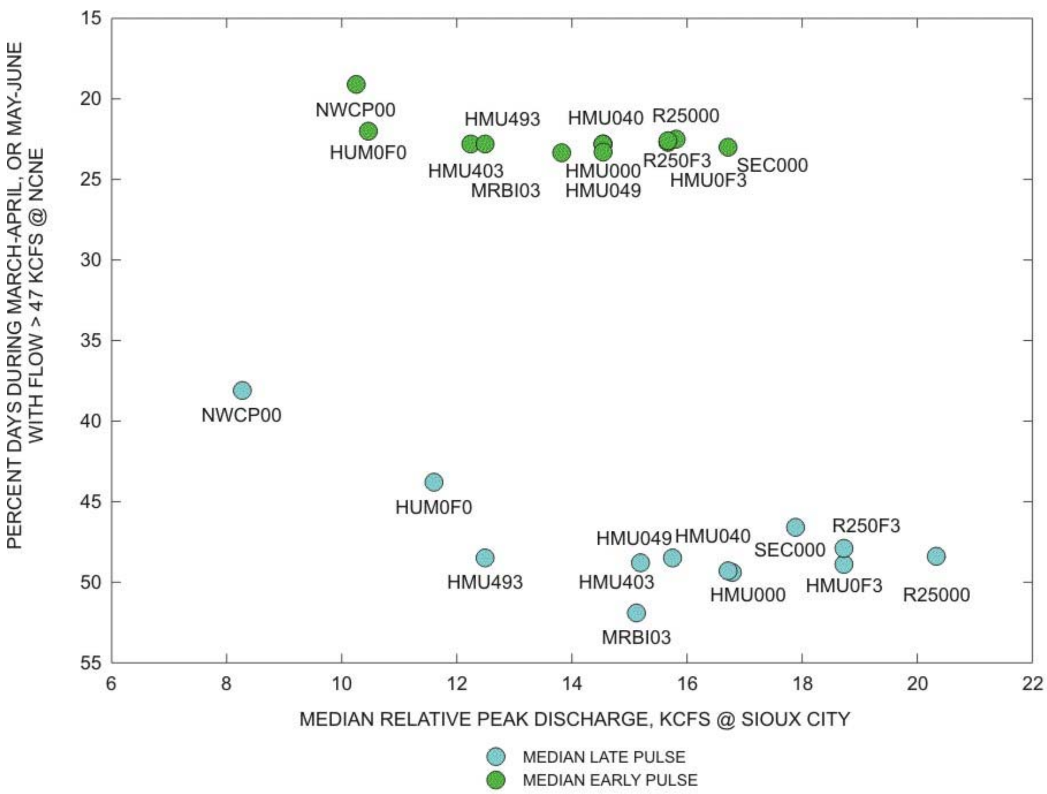

Figure 3. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and median relative peak discharge of the early and late pulses of the spring rise.

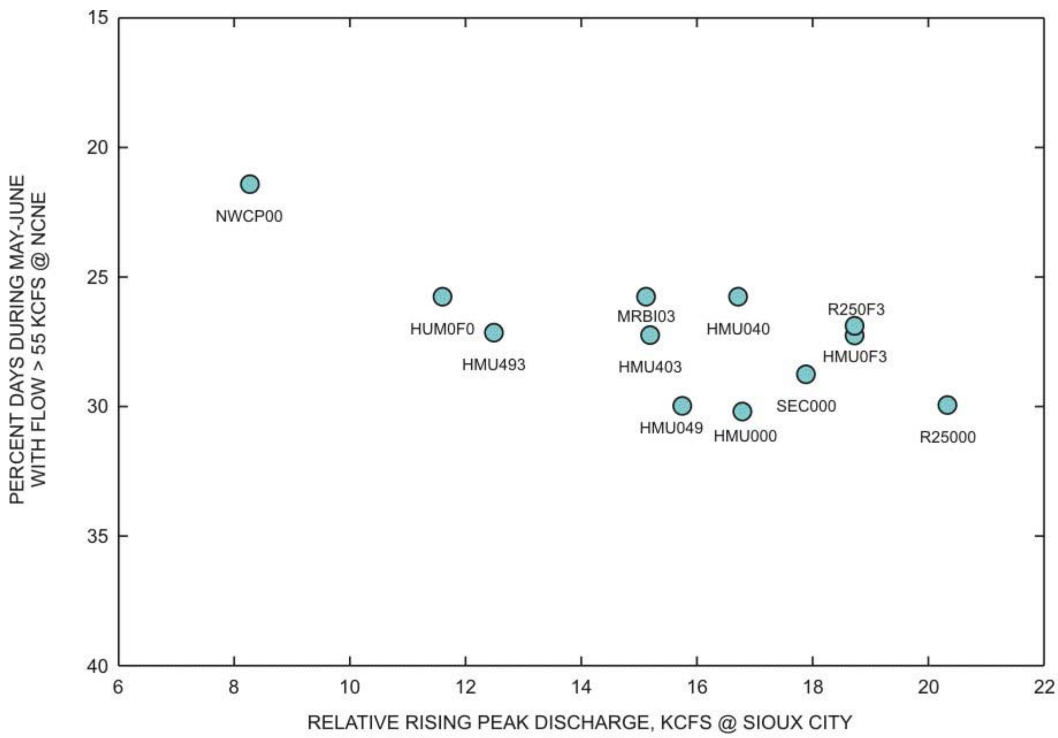

Figure 4. Graph of percent days of flows greater than 55 kcfs at Nebraska City, and median relative peak discharge of the late pulses of the spring rise.

Figure 5 illustrates trade-offs using percent days exceeding the 47 kcfs criterion at Nebraska City against the numbers of peaks per year for the early and late pulse. Pulses were counted as spring rises if they satisfied criteria for rate of increase and persistence, and if the relative peak discharge was greater than the 25th percentile of the relative peak discharge of pulses in the reference (natural) hydrograph. Other criteria were also investigated and the shape of the trade-off curve was relatively insensitive to the measures. The absolute count of rises per year, however, is extremely sensitive to the criteria used to define a significant pulse.

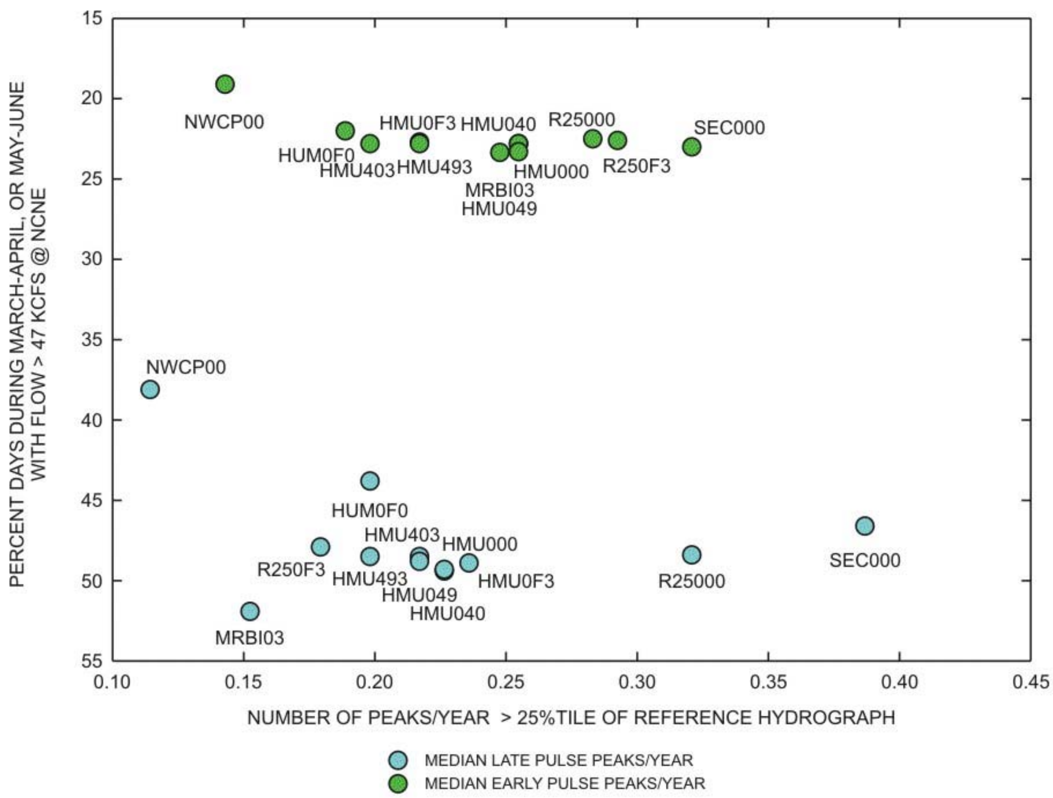

Figure 5. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and number of spring pulses per year in excess of the 25th percentile of the reference run-of-the-river hydrograph.

Figure 6 shows the trade off between percent days exceeding official flood stages at St. Joseph and Boonville, Missouri and median relative peak discharges of the late pulse attained by the various alternatives. Similar to the flap-gate criteria, exceedance of flood stage is relatively insensitive to the flow alternatives.

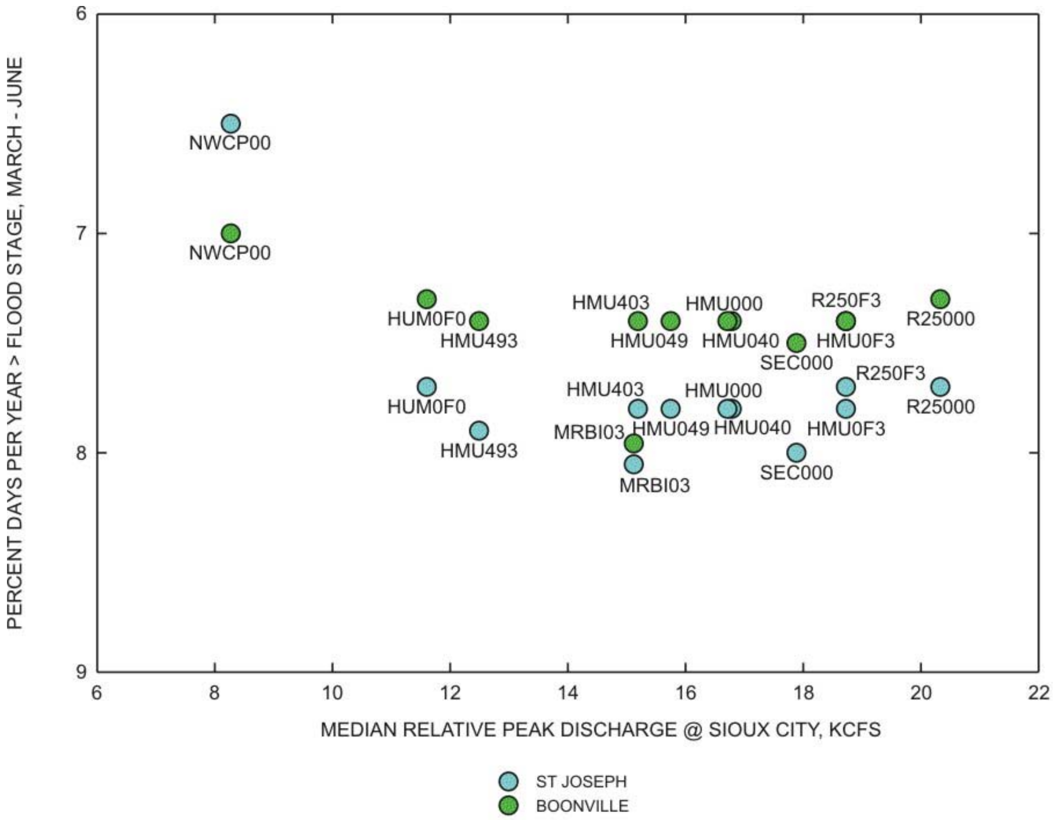

Figure 6. Graph of percent days of flows greater than flood stage at St. Joseph and Boonville, and median relative peak discharge of the early and late pulses of the spring rise.

Figure 7 illustrates the same trade off measuring benefit to the pallid sturgeon using number of peaks per year.

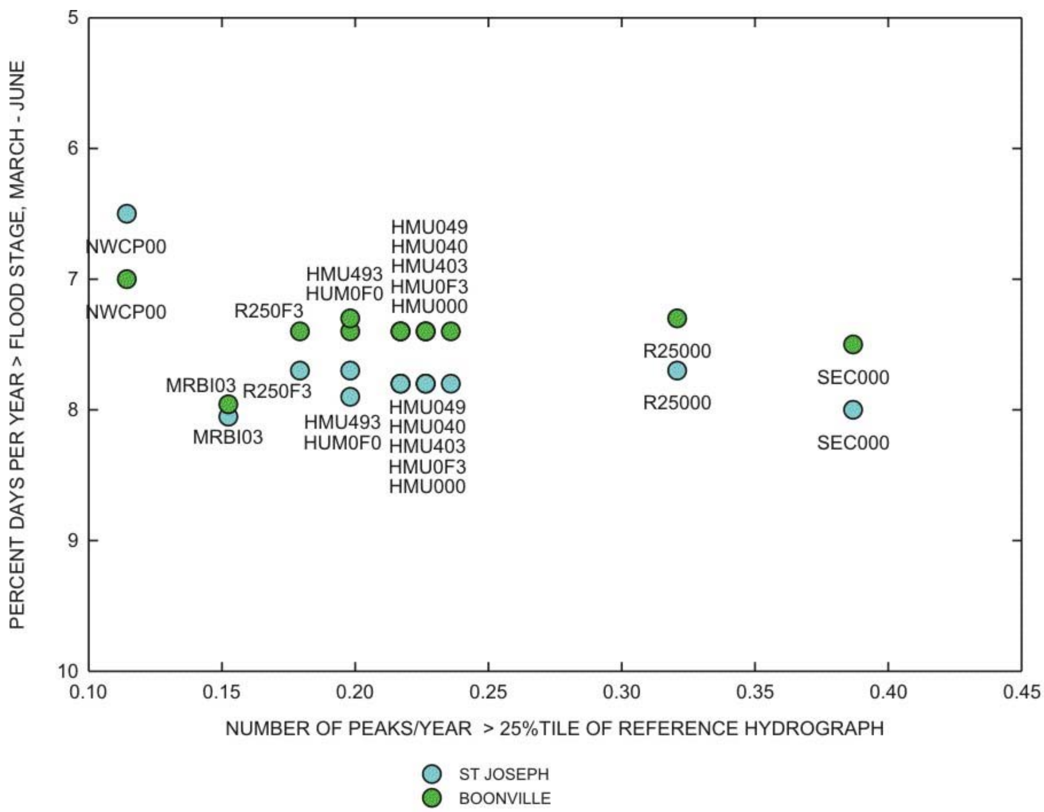

Figure 7. Graph of percent days of flows greater than flood stage at St. Joseph and Boonville, and number of spring pulses per year in excess of the 25th percentile of the reference run-of-the-river hydrograph.

Figure 8 assesses the trade-off between lower decile (10% lowest years) annual system storage and the median peak discharge of the late pulse, and figure 9 does the same for the lower quartile (15% lowest years). Unlike the other trade-off relations, these relations show linear decreases in system storage with increases in the relative peak discharges.

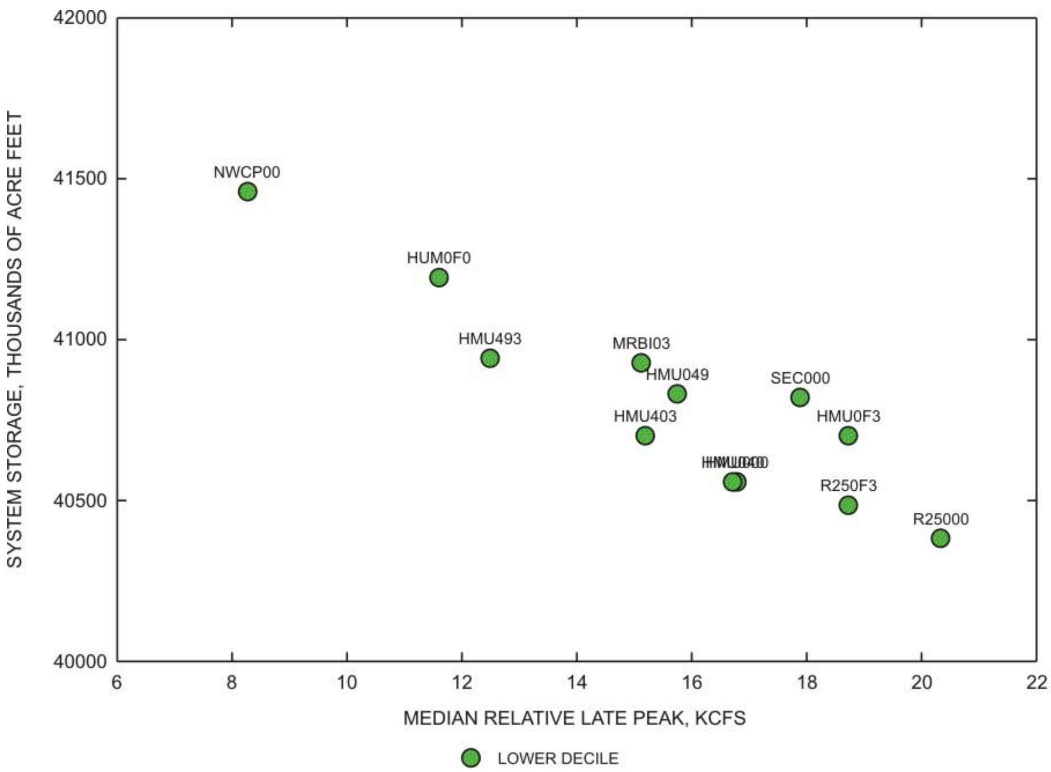

Figure 8. Graph of lower decile system storage and median relative peak discharge of the early and late pulses of the spring rise.

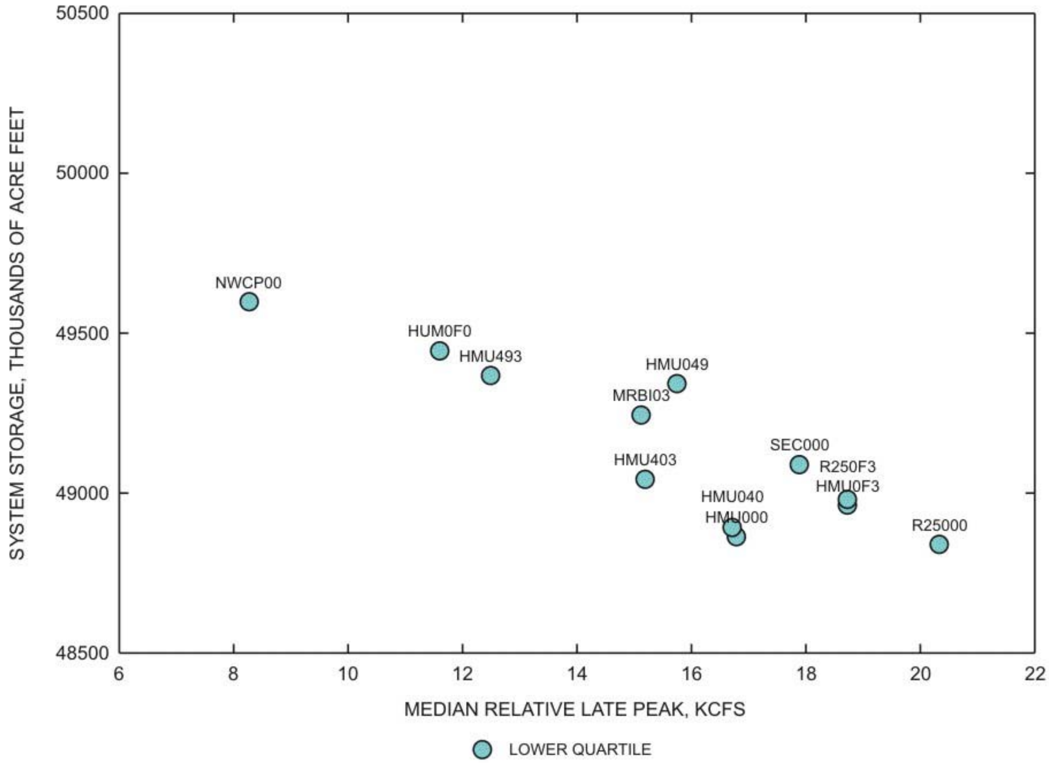

Figure 9. Graph of lower quartile system storage and median relative peak discharge of the early and late pulses of the spring rise.

Hydrograph Type Comparisons

Figures 10-12 illustrate the trade-offs among the three hydrograph types (R25 series, HMU series, and SEC series) and two reference hydrographs (NWCP00 and MRBIO3). Figure 10 shows that all three plenary alternatives perform similarly and that all three achieve greater median relative peak discharge than MRBIO3. Figure 11 shows the same trade-off using flood stage at St. Joseph and Boonville. Figure 12 shows the lower decile of system storage associated with median relative peak discharges for the main hydrograph types.

Figure 10. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and median relative peak discharge of the early and late pulses of the spring rise. Limited to main types of hydrographs, 31 MAF preclude, full increase in flood control constraints.

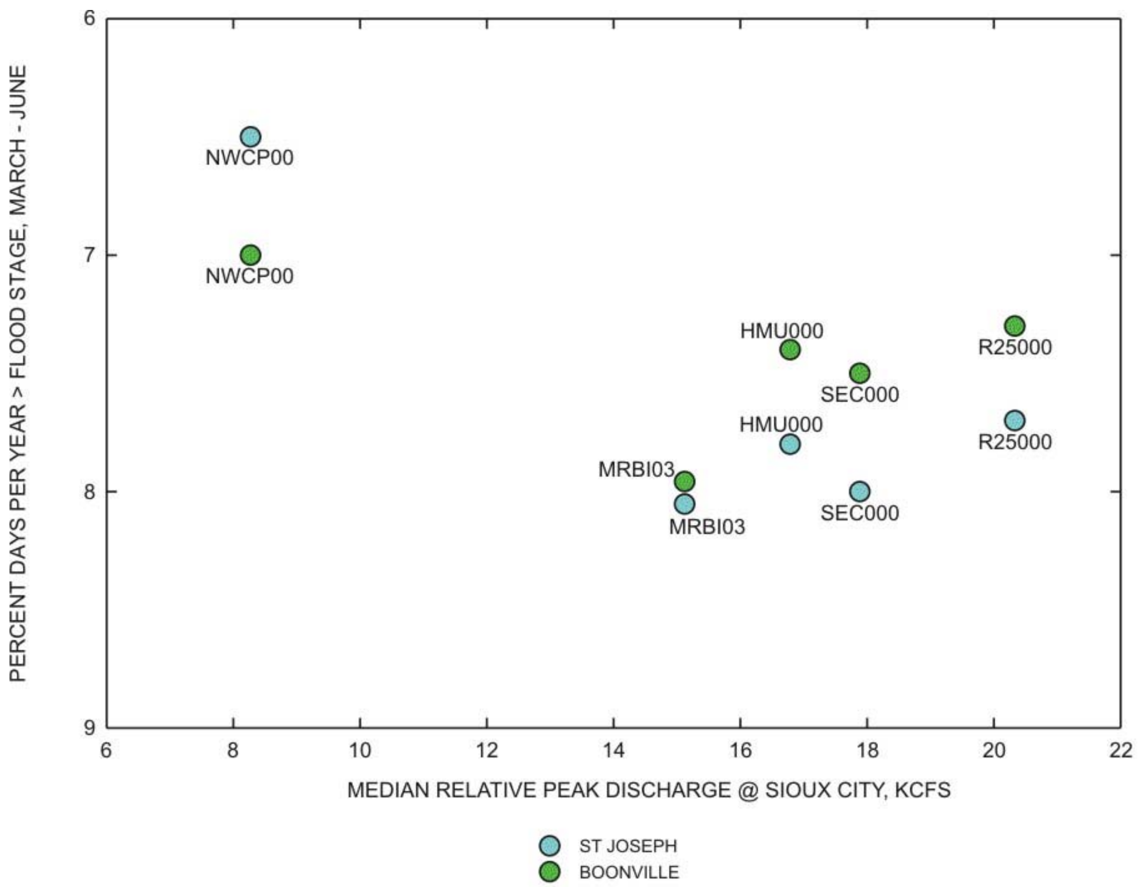

Figure 11. Graph of percent days of flows greater than flood stage at St. Joseph and Boonville, and median relative peak discharge of the early and late pulses of the spring rise. Comparison

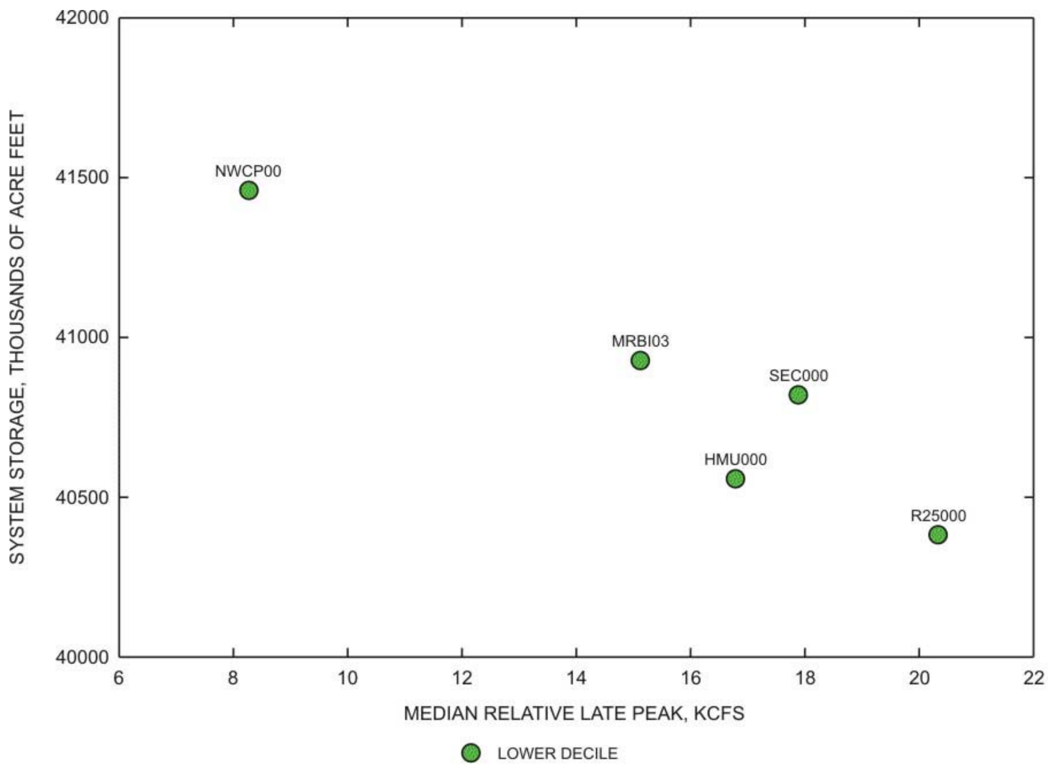

Figure 12. Graph of lower decile system storage and median relative peak discharge of the late pulses of the spring rise. Comparison of main alternative hydrographs.

Drought Preclude Comparisons

Figures 13-15 show tradeoffs between the same suite of costs and benefits but use only the HMU000, HMU040, and HMU049 series to illustrate the effect of drought precludes at 31, 40, and 49 MAF, respectively. In all cases, HMU040 (40 MAF preclude) and HMU000 (31 MAF preclude) plot very close together. HMU049 drafts somewhat less from system storage and achieves somewhat smaller relative peak pulse.

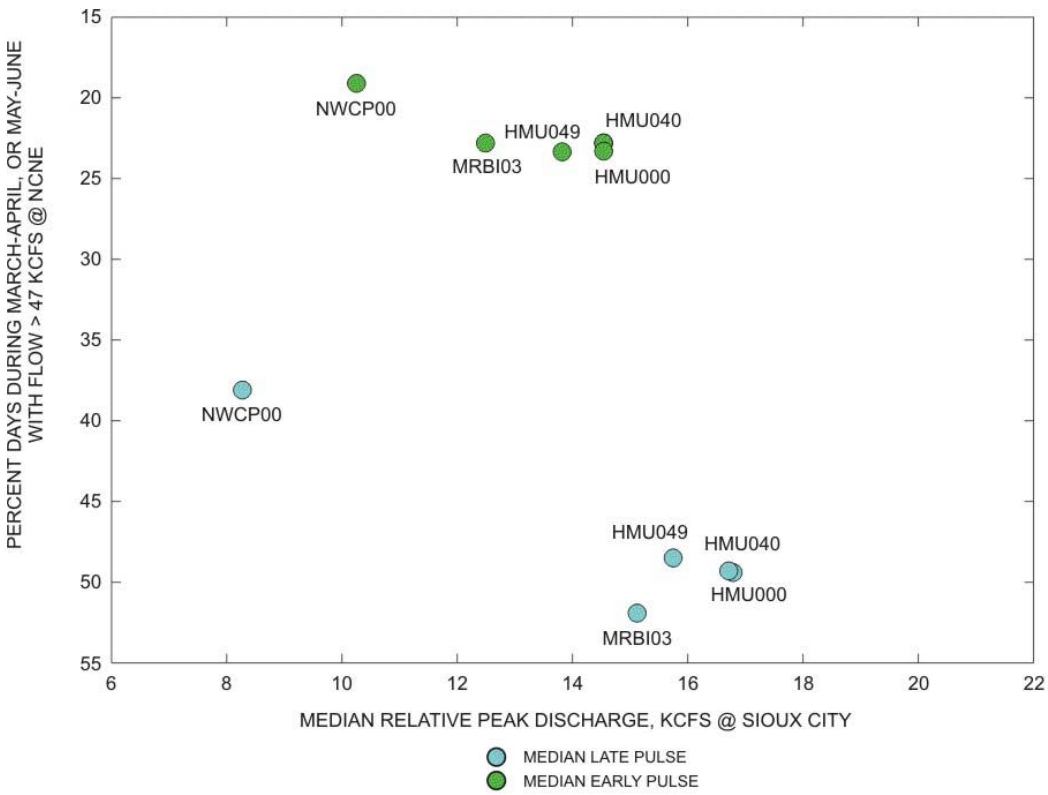

Figure 13. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and median relative peak discharge of the early and late pulses of the spring rise. Comparison with only HMU series to illustrate effects of changing drought precludes.

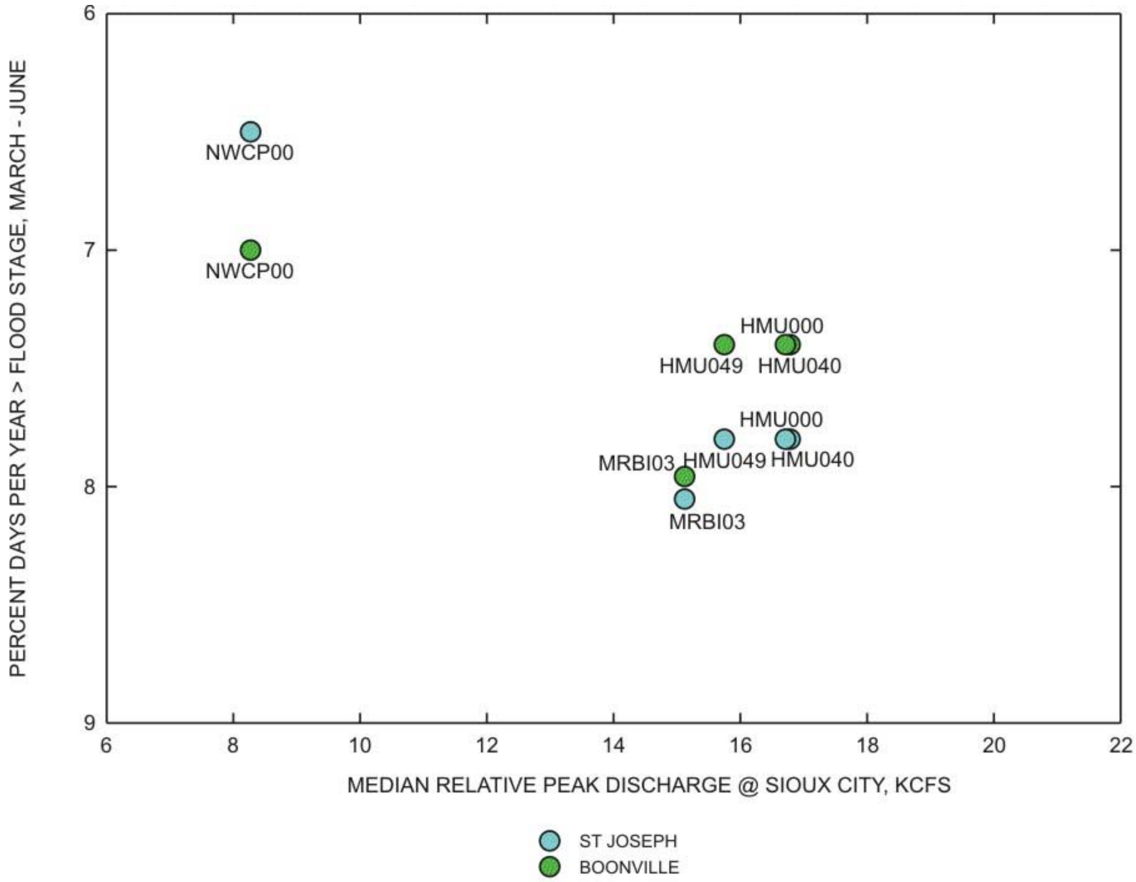

Figure 14. Graph of percent days of flows greater than flood stage at St. Joseph and Boonville, and median relative peak discharge of the early and late pulses of the spring rise. Comparison among drought preclude series.

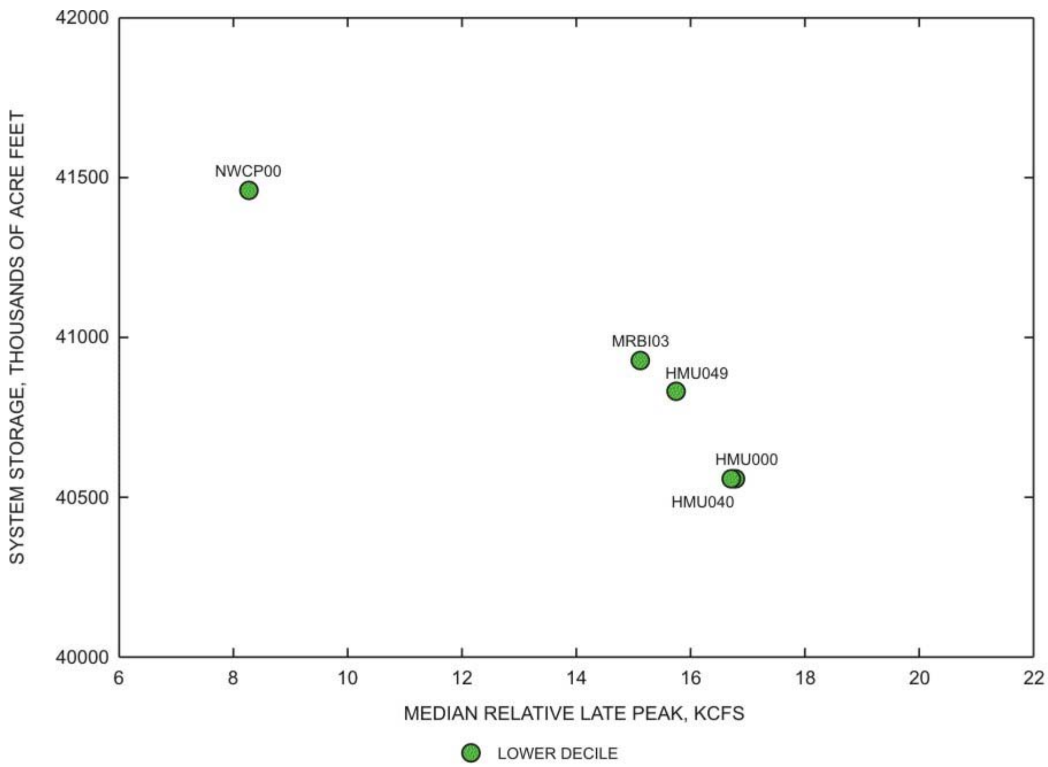

Figure 15. Graph of lower decile system storage and median relative peak discharge of the early and late pulses of the spring rise. Drought preclude series.

Flood Control Constraint Comparisons

Figures 16-19 show the effects of varying flood-control constraints on relative costs and benefits using the HUM series. The series without F as the penultimate letter in the name have flood control constraints raised equal to the size of the pro-rated spring rise. The series ending in F3 have minimal raises in flood-control constraints (see explanation in earlier documents) and the HMU0F0 has no increase in flood control constraints. Flood control constraints act to decrease releases at Gavins Point to full or minimum service flows, when downstream discharges exceed the targets. In figure 16 it is evident that imposing minimum flood-control constraints (F3 runs) on the hydrograph decreases relative peak discharge benefits to the pallid sturgeon without appreciably increasing interior drainage benefits. The HMU0F0 alternative with no increase in flood control constraints results in increased interior drainage benefits as well as decreased benefits to the pallid sturgeon.

Figure 16. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and median relative peak discharge of the early and late pulses of the spring rise. Flood control constraints comarisons.

Figure 17 presents a comparison of potential impeded interior drainage and the number of spring rises. Importantly, the count of spring rises in figure 17 is based on those identified by the Corps as purposeful spring rises at Gavins Point. This measure of spring rise occurrence differs somewhat from measures extracted from the hydrograph at Sioux City and compared to the reference hydrograph (fig. 5), as the latter measures all rise features occurring at Sioux City, including natural rises from tributaries between Gavins Point and Sioux City. The graph indicates that there is little trade-off in interior drainage concerns with number of pulses for the early rise. For the late rise, a substantial trade-off occurs from the NWCP to HMU0F0 to HMU493, with number of rises increasing from 0 to 50 and days with flows > 47 kcfs increasing by 10 percent of days. Among the remaining HMU alternatives, flood control constraint variation does not result in much change in percent days > 47 kcfs at NCNE, but numbers of spring rises vary from 50 to 80 in 107 years.

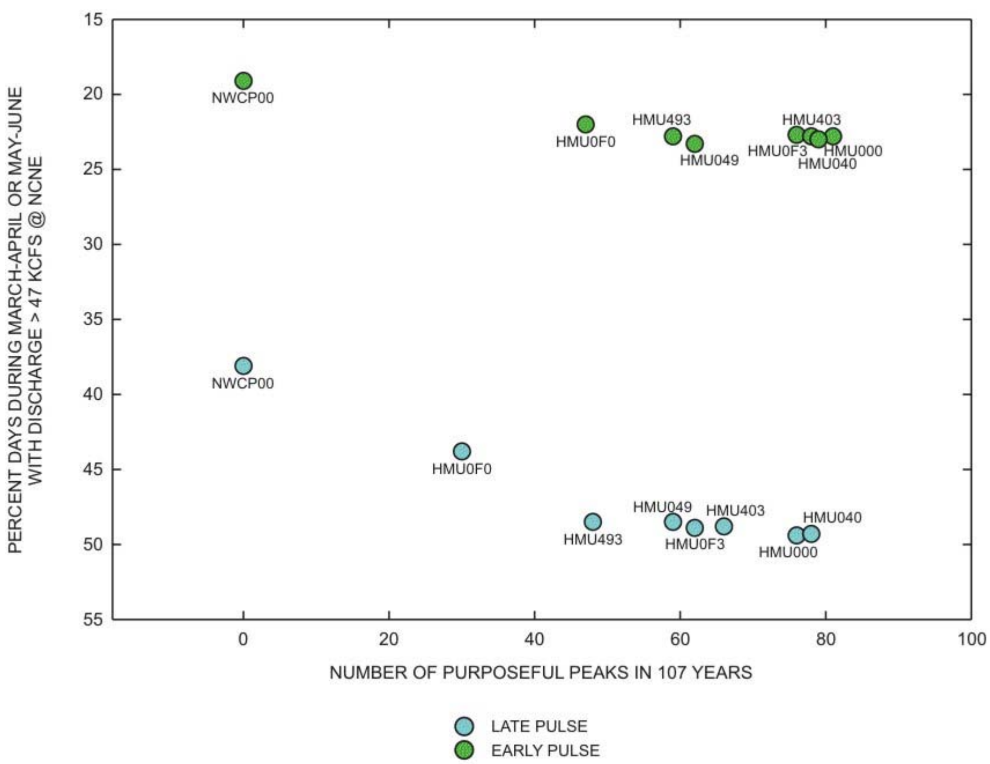

Figure 17. Graph of percent days of flows greater than 47 kcfs at Nebraska City, and number of purposeful spring pulses per year. Purposeful pulses count the number of pulses created by purposeful releases from Gavins Point Dam.

Figure 18 illustrates the trade-off between flows over flood stage and relative peak discharge at Sioux City. Generally, discharges greater than flood stage are insensitive to the flood control constraint used. Decreasing the constraint tends to decrease the size of the relative peak flow at Sioux City, except for the HMU0F3 alternatives, which tend to have larger peak discharges for the spring rise compared to HMU000. This may indicate that some additional pulses were counted under the HMU0F3 flood control constraint in instances in which releases were cut short, thereby forming a peak from what might otherwise have been a flat discharge.

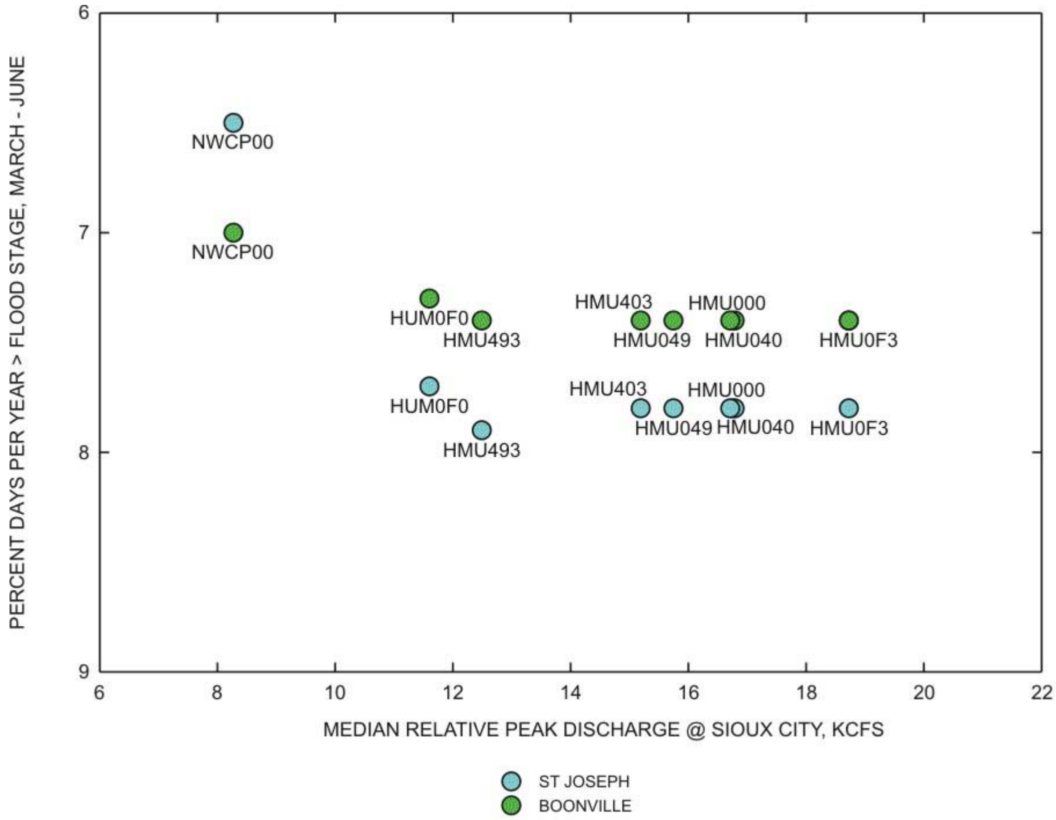

Figure 18. Graph of percent days of flows greater than flood stage at St. Joseph and Boonville, and median relative peak discharge of the early and late pulses of the spring rise. Comparison

Figure 19 shows lower decile system storage levels and median relative peak discharges at Sioux City. Similar to other variations of this plot, the trade-off relation is linear, indicating that additional storage savings accrues with decreased size of the spring rise. Among the flood control constraint scenarios, decreased constraints generally are associated with increasing storage and decreasing relative peak discharge. This generalization does not hold for alternative HMU0F3 which, produces higher spring rises and is associated with higher system storage.

Summary

The simplified trade-off analysis presented here provides illustrations of relative gain or loss of value, with emphasis on comparing losses (days of potentially impeded interior drainage, days with flows greater than flood stage, and decreased system storage) with presumed benefits for the pallid sturgeon (numbers of pulses per year, median relative peak discharge of the pulses).

The measures shown here indicate that the flood-control – pallid sturgeon trade-off for Missouri River spring rise alternatives is generally a concave upward function, indicating substantial losses of flood control benefits for gains of pallid sturgeon benefits. Most of the trade-off, however, is moving from the current water control plan (NWCP) to the multiple-use alternative with no increase in flood control constraints (HMU0F0), and from HMU0F0 to the others. Eliminating NWCP and HMU0F0 from the analysis indicates a nearly level trade-off such that increases in potential pallid sturgeon benefit are associated with little loss in flood control benefits.

Trade-offs between measures of pallid sturgeon benefits and total system storage indicate a linear relationship such that increasing pallid sturgeon benefits are associated with decreasing system storage during drier years.

Table 2

Average Annual Number of Days that the Flood Stage minus X Flow is Exceeded at Lower River Locations Relative to the New Water Control Plan for Changes in the Drought Precludes (full increase in flood control constraint option)

	Gage Locations with FS-X Flows for Each Location				
Amount of Change	NC-47 kcfs	SJ–55 kcfs	KC-66 kcfs	BN-86 kcfs	HM-110 kcfs
First Rise					
NWCP Value	11.7	11.0	13.6	12.8	15.4
31 MAF (81)	2.3	1.8	0.5	0.1	0
40 MAF (79)	2.3	1.8	0.5	0.1	0
49 MAF (62)	2.6	1.9	0.5	0.1	0
Second Rise					
NWCP Value	23.2	22.4	24.6	20.3	22.4
31 MAF (76)	6.9	4.6	2.4	1.6	0.9
40 MAF (78)	6.8	4.6	2.3	1.6	0.9
49 MAF (59)	6.3	4.4	2.3	1.5	0.8

Glossary

Deposition-The process of laying down sediments after a transportation process (sedimentation).
Drawdown-The distance that the water surface of a reservoir is lowered from a given elevation as water is released from the reservoir. Also refers to the act of lowering reservoir levels.
Drought Conservation-Reduction of releases from the Mainstem Reservoir System to conserve water in the reservoirs for authorized project purposes.
Endangered-A plant or animal species that is in danger of extinction throughout all, or a significant portion, of its range. The U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) designates endangered species.
Erosion-The wearing away of a land surface or river channel by water, wind, ice, gravity, or other geological activities.
Eutrophication-The build-up of nutrients in a water body that promotes excessive algal growth.
Flat Release-Constant release of water from Gavins Point Dam to meet a prescribed release requirement (flat release for endangered species during the summer) or a subsequent minimum flow requirement downstream (navigation target requirements from May through August).
Floodplain Connectivity-Flooding of lands along the river to flush nutrients, an aquatic food source, into the river. Historically, flood flows in the spring caused this to happen on a fairly regular basis.
Habitat-The environment occupied by individuals of a particular species, population, or community.
Levee-A dike or embankment that protects land from flooding.
Lower River-The segment of the Missouri River that extends from Gavins Point Dam to the mouth of the river near St. Louis.
Mainstem Reservoir System-The portion of the Missouri River from the headwaters of Fort Peck Lake to Gavins Point Dam that includes the six large dams and their reservoirs.
Master Manual-The document that describes the Mainstem Reservoir System, including its Water Control Plan. The document establishes operational policy for the multiple project purposes of flood control, hydropower, water supply, water quality, irrigation, navigation, recreation, and fish and wildlife.
Navigation Season-The period of time that flow support is provided to serve navigation on the Lower River from Sioux City to the mouth near St. Louis. The length of a normal navigation season is 8 months (April 1 through December 1).
Navigation Service-The release of water from the Mainstem Reservoir System necessary to maintain 8 to 9 feet of water depth in the navigation channel between Sioux City and St. Louis.
Permanent Pool-The minimum water level necessary to allow the hydropower plants to operate and provide minimum service to recreation and fish and wildlife. The permanent pool also provides reserved space for sediment storage.
Release of Water-The controlled discharge of water from a reservoir to serve one or more authorized purposes.
Reservoir-An artificial body of surface water retained by a dam.
Riparian Habitat-The area adjacent to a stream channel, a reservoir, or wetland that supports the growth of woody vegetation that is not adapted for life in saturated soil conditions.
Run of River-Flows that are basically uncontrolled.
Sedimentation-The process of deposition of sediment.
Shallow Water Habitat-Areas along the river that are less than 5 feet deep, flowing at no more than 2.5 feet per second.
Spawning Cue-River conditions that prompt fish to spawn. For the pallid sturgeon and other native river fish, a spring rise on the Lower River may prompt spawning.
Tailwater-The river reach immediately downstream from a dam.
Threatened-Legal status afforded to a plant or animal species likely to become endangered within the foreseeable future throughout all or a significant portion of its range, as determined by the USFWS or the NMFS.
Upper Reservoirs-The three most upstream Missouri River reservoirs formed by Fort Peck Dam, Garrison Dam, and Oahe Dam.
Water Control Plan-A detailed plan outlining the guidelines for operation of the Mainstem Reservoir System that is contained in the Master Manual.
Wetland Habitat-Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions.

Acronyms/Abbreviations

AOP	Annual Operating Plan
BA	Biological Assessment
BiOp	Biological Opinion
Corps	U.S. Army Corps of Engineers
CWCP	current Water Control Plan
DEIS	Draft Environmental Impact Statement
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
GIS	Geographic Information System
kcfs	thousand cubic feet per second
MAF	million acre-feet
Master Manual	Missouri River Master Water Control Manual
MCP	Modified Conservation Plan
MRRIC	Missouri River Recovery Implementation Committee
MRRIP	Missouri River Recovery Implementation Program
MW	megawatt
MWh	megawatt-hours
NEPA	National Environmental Policy Act
PA	Preferred Alternative
PDEIS	Preliminary Draft Environmental Impact Statement
PRDEIS	Preliminary Revised Draft Environmental Impact Statement
RDEIS	Revised Draft Environmental Impact Statement
RHM	Reservoir Habitat Model
ROD	Record of Decision
ROR	run of river
Study	Master Water Control Manual Review and Update
System	Missouri River Mainstem Reservoir System
USFWS	U.S. Fish and Wildlife Service
WAPA	Western Area Power Administration

Supplemental Glossary Terms

Acre-Foot - The volume of water that would cover one acre of land (43,560 square feet) to a depth of one foot, equivalent to 325,851 gallons of water.

Annual Operating Plan – The AOP provides a framework for the development of regulation schedules for the System's six mainstem dams during the upcoming year to serve the Congressionally authorized project purposes. The AOP is based on water management guidelines found in the Missouri River Master Water Control Manual. A Draft AOP for the next operational year is typically issued in September, with Public Meetings held in October and November to obtain public input, and a final AOP is issued in December or January, for implementation in March, during which a set of spring Public Meetings is typically held.

Flap Gates – Flap gates are covers for drainage structures (usually a concrete culvert or corrugated metal pipe) to allow flow from one direction only. They are designed to open easily in the direction of flow and to seal shut to prevent water from flowing back.

Flood Control Constraints – The Missouri River Master Water Control Manual (refer to Tables VII-7 and VII-8) contains more detailed information on Flood Control Constraints in the paragraphs that address "Flood Target Flows". As a flood control measure, the normal relationship between service levels and target flow levels may be modified when large amounts of tributary inflow are forecasted between Gavins Point Dam and the downstream flow target control points. One level of flood target flows reduces flows to that consistent with full service and the second level of flood target flows reduces flows to that consistent with minimum service

Flood Stage – The stage at which overbank flows are of sufficient magnitude to inundate lands adjacent to the river. Typically, along the Missouri River, this is the stage that potential damage to crops and structures outside of levees occurs.

Magnitude, Frequency, Duration – With respect to the Spring Rise releases, the **Magnitude** is the amount that the release is above the normal release for that time. The **Frequency** is how often this increase would occur, and the **Duration** is the length of time that the release would be above normal releases.

Preclude – The total System storage in MAF below which the release of water to support a specific use would be suspended or precluded. For example, the Navigation Preclude is 31 MAF; therefore, when the total System storage drops below 31 MAF, releases for navigation are suspended. The Spring Rise Preclude has yet to be determined.

Proration – With proration, the magnitude of the Spring Rise release is proportionally adjusted based on the amount of water in total System storage. A higher total System storage amount would provide a proportionally higher Spring Rise release.

Reference Hydrograph – The Reference Hydrograph is the “run-of-river” hydrograph. Data from the Corps’ simulation of “run-of-river” was used to develop the reference hydrograph. (See “run-of-river”)

Steady Release – Flow to Target – This release schedule is used to protect nesting interior least terns and piping plovers. The initial steady release is based on hydrologic conditions and the availability of habitat at that time (steady release). If the steady release becomes inadequate to meet downstream target flows, the release is increased to meet downstream target flows (flow to target). The purpose of this regulation is to continue to meet the project purposes while minimizing the loss of nesting threatened and endangered bird species and conserving water in the upper three reservoirs during droughts. It also provides certainty for downstream users that releases could be increased if needed to meet target flows.

Total System Storage – The total volume of water stored in the reservoirs behind the six mainstem dams. Total System Storage is usually expressed in Millions of Acre Feet (MAF).

<u>Pallid Sturgeon Research and Monitoring (Spring Rise in 2006 or not)</u>

- Population assessment
- Track fish
- Catch fish that are believed to have spawned
- Nets below likely spawning areas to try and catch larvae
- Habitat assessment
- For pallid sturgeon activity, try and determine relative importance of flow, turbidity, temperature, and photoperiod

- In the short term, need team of experts to lead this – two people are necessary: a program administrator, and a science administrator (Corps/FWS/USGS); once recovery committee is on line, need to develop integrated monitoring and research program and an adaptive management program tied to independent science and including multi-stakeholder involvement

- Expert group needs to develop a 10-year study design for pallid sturgeon; we need ongoing research, but also focused projects that answer specific questions related to pallid sturgeon life history

- Need to focus on Gavins Point reach AND reach in Missouri where there is already a "natural" spring rise to address concerns from public meeting; need to be able to make comparisons and to be able to address issue of what's happening in reach where there is already a spring rise due to precipitation and substantial tributary input; this may require additional resources and manpower over and above ongoing research and monitoring

- Team of experts should develop recommendation that Pallid Sturgeon Recovery Team allow a percentage of sexually mature adults in river to track and catch them; try to get some adults left in river instead of all going immediately into propagation facilities

- Open and transparent process to prioritize monitoring objectives; we need to focus on pallid sturgeon, but we can't sacrifice ongoing monitoring on things like tern & plover habitat and other projects for increased pallid sturgeon monitoring

- Outreach of information on a continual basis to stakeholders should be a priority

Socio-Economic Technical Working Group Spring Rise Proposal

Draft of August 15, 2005

Title of Option: Modified Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21)

Note: Excluding fish and wildlife resource interests (an authorized use which would continue to be significantly compromised/impacted) and certain recreational users, the members of the Socio-Economic Technical Working Group (SETWG) expressed unanimous support for the recommendations contained in this report. (The strongest divergence of opinion centered on the desirability of a single or bimodal rise.)

1. Description of the Proposal:

Tables 1A and1B provide general rationale for the following:

a. Number of Rises:

Strong preference for 1 mode; however, the SETWG has noted its preferences regarding a second rise should it be required below.

b. Flood Control Targets/constraints:

Minimal to no adjustment.

c. Timing, duration, magnitude, rise and fall rates of First Rise:

- **Timing:** Start of the First Rise should begin soon enough so release levels coincide with minimum navigation service release levels from Gavins Point by March 23rd (rise should begin March 21- 22 and decline to flow-to-target minimum navigation service levels by April 7th)
- **Magnitude:** < 35 kcfs. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible

d. Timing, duration, magnitude of Flow Between Rises:

Minimum water usage (i.e. flow-to-target navigation service)

e. Timing, duration, magnitude, rise and fall rates of Second Rise:

- **Timing:** Timing should be such that the initial 30% decline from the peak of the Second Rise should be completed as close as possible to May 21st.
- **Magnitude:** $\leq$52 kcfs. The critical component of magnitude is the length of time the peak is above the critical floodgate gate gage level (CFGGL, yet to be determined). Specifically, the peak above the CFGGL should be as short as possible, 1-3 days. Magnitude should be prorated based upon storage and the most up-to-date runoff predictions for areas above and below Sioux City. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible down to the CFGGL. Duration and rate of fall are less critical once levels are below the CFGGL.

f. **How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes):**

This rise is designed for dry conditions with regard to low mainstem storage levels and low runoff levels. By starting the rise later in May, storage is saved in upper basin reservoirs. Flow-to-target during May benefits system storage relative to the CWCP. Starting the second rise at flow-to-target levels will lessen the magnitude while still maintaining the delta (stage change). Mountain snowpack generally begins entering the system later in May allowing for timely replacement of storage in mainstem reservoirs. At the same time, by May 21, possibly earlier, agricultural interests down river face the inability to replant if the peak results in interior drainage problems.

Group should discuss stop protocols.

Flooding and/or a spring rise resulting in mainstem storage dropping to a level that threatens water intakes in the reservoirs (38 MAF)

g. **Volume of water used**:

Design incorporates socioeconomic recommendations into the Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21). The SETWG will attempt to provide this calculation for presentation to the Plenary Group.

2. Hydrograph chart (with sideboards visually noted):

SETWG will attempt to have a hydrograph completed for presentation to the Plenary Group.

3. Anticipated effects

a. **Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):**

This proposal works off of recommendations from the Pallid Sturgeon Technical Working Group.

b. **Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects)**:

The group provides general observations regarding impacts in Table 2. A thorough accounting of impacts is necessary and will require formal study.

c. **Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):**

This proposal will minimize losses to mainstem system storage. In fact because the May peak will now more closely coincide with mountain snowpack runoff, mainstem system storage from the start to finish of the spring rise may realize little relative change.

4. Brief description of monitoring methods and indicators:

A monitoring regime that measures impacts of the Spring Rise to all socio-economic interests/uses should be in place prior to implementation. The SETWG lacked expertise to develop a list of indicators and strategies and therefore recommends that an expert and impartial third party is identified to develop a monitoring regime. An ad-hoc committee should be appointed to select this group. The SETWG believes that mitigation and/or compensation strategies that are closely tied to the results of monitoring efforts should be evaluated.

Table 1A, Socio-Economic Interests Regarding Certain Characteristics of a ***First*** 2006 Spring Rise

	Duration	**Timing**	**Quantity**	**Modes**	**Rate of Rise**	**Rate of Fall**	**Pre-Rise Discharge**[1]	**Preclude**[2]	**Prorate**[3]	**Flood**[4] **Control Constraint**
Use	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3		4	4	0
Hydro	S	L	1	1	3	3		4	4	0
Therm	S	L[5]	1	1	3	3		4	4	0
Nav	S	E	1	1	3	3		5	5	0
W Supp	S	L	1	1	3	3		4	4	NA
W Qual	S/L[6]	L	1/2/3[7]	1	3	3		3	4	NA
Irr	S	E	1	1	3	3		3	4	NA
Rec	S	L[8]	1	1	3	3		3	4	NA
Ag	S	E[9]	1	1	3	3		5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1		1	1	=

[1] Since system releases are at CWCP winter release levels prior to the first rise, pre-rise discharge is not an issue.

[2] These two terms are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.

[3] Spring Rise may be prorated based on system storage or runoff.

[4] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.

[5] July or August.

[6] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.

[7] Ibid.

[8] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.

[9] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period.

Table 1B, Socio-Economic Interests Regarding Certain Characteristics of a ***Second*** 2006 Spring Rise										
	Duration	**Timing**	**Quantity**	**Modes**	**Rate of Rise**	**Rate of Fall**	**Pre-Rise Discharge**	**Preclude** [10] [11] [12]	**Prorate** [13]	**Flood[14] Control Constraint**
Use	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3	1	4	4	0
Hydro	S	L	1	1	3	3	1/2[15]	4	4	0
Therm	S	L[16]	1	1	3	3	1/2/3[17]	4	4	0
Nav	S	E	1	1	3	3	3[18]	5	5	0
W Supp	S	L	1	1	3	3	1/2[19]	4	4	NA
W Qual	S/L[20]	L	1/2/3[21]	1	3	3	1/2[22]	3	4	NA
Irr	S	E	1	1	3	3	1	3	4	NA
Rec	S	L[23]	1	1	3	3	1	3	4	NA
Ag	S	E[24]	1	1	3	3	1/2/3[25]	5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1	1	1	1	=

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[10] Spring Rise may be precluded based on system storage or runoff. Responses were made on the basis of a water consumptive spring rise. If the spring rise added water to storage in mainstem reservoirs through the flexibility afforded by a low (i.e. winter release level) pre-rise discharge, then a preclude would not be requested.

[11] If the annual spring rise in Oahe reservoir falls below 1578' feet MSL elevation on March 15, 2006 and/or if projections show at any time an MSL elevation for Oahe at or below 1567' we recommend a preclude to a 'spring rise' release. Maintaining these elevations is absolutely critical in maintaining an adequate water supply for at least 14,000 people living on or near the Cheyenne River Sioux Tribe Indian Reservation in central South Dakota.

[12] Preclude and proration are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.

[13] Spring Rise may be prorated based on system storage or runoff.

[14] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.

[15] Releases should be sufficient to meet normal hydropower demands. Winter releases, a period of high power demand, are around generally about 11 kcfs. Pre-rise discharge would be at a time of lower power demand, April-May. Therefore a 1 is likely warranted. Moreover, by increasing storage, head is increased above the turbines and more water is available for release during the summer, another period of high hydropower demand.

[16] July or August.

[17] Low releases during April-May would not impact thermal power production. It may be a positive as more water would be available during the summer when greater quantities are needed for cooling. If the Spring Rise is later than April, a 2 would be more appropriate. If the second rise is later than May, a 3 may be more appropriate.

[18] See xxvi

[19] Releases should be sufficient to meet water supply needs. Water supply needs are met at winter release levels for riverine intakes. Early season (April/May) releases could be similar to winter releases and still meet riverine water intake/supply needs. Additionally, increased storage would benefit reservoir based water intakes. Therefore a 1 is likely warranted.

[20] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.

[21] Ibid.

[22] Ibid.

[23] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.

[24] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period. *Dave Sieck will further clarify as necessary.*

[25] A lower pre-rise discharge would increase flood protection to flood plain agriculture.– Spring rise releases which decrease reservoir levels potentially decrease navigation days/service levels, or worse case scenario, precluding navigation (1" of service level = 17 tons/barge). The decreased flows would directly impact efficiency of the middle Mississippi River. (Note: Total economic impact to upper MS/IL River $2.3 billion/yr). If flow is reduced below navigation service levels in April, navigation would be severely crippled, since historically 40% of ag business is in April/early May. 1 barge = 58 trucks/increases to air pollution. Terminal access could be limited/lost by flooding during "rise." Declining reservoir levels would long-term negatively impact water available for navigation. Man-made flooding degrades navigation channel.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Flood Control	FEMA Flood Insurance Program	Ruling from FEMA	National Weather Service/USACE	Policy Change / Pay no matter what
Flood Control	Internal Drainage	Pumping and/or Flood Insurance	Levee Board/USACE	Pay pumping costs and all crop loss
Flood Control	Bank Erosion above revetment	Rip-rap/rock is too low. It needs to be higher up the revetment	Levee Board/USACE	Replace revetment to project authorization
Flood Control	Levee overtop	Raise Levees	Levee Board/USACE	Policy change – pay for all floods including small floods. (or) Raise/Move levees (USACE pay)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Hydropower	Flow regime changes from Gavins Point Dam required to support a Spring Rise may result in a shift in Mainstem hydropower generation from periods of peak electrical demand to off-peak periods. Such shifts could result in increased costs to the Western Area Power Administration (WAPA) to supply their firm commitments, thereby increasing the costs to their customers.	Additional costs ($) associated with hydropower capacity and energy marketed by WAPA.		
Hydropower	Flow regime changes from Gavins Point Dam required to support a SR will result in a shift in mainstem hydropower generation from seasonal periods of high demand to seasonal periods of low demand. Shifting generation to low demand periods has two impacts. Generation surpluses to Western's contractual commitments is sold at very low prices. To the extent that less water is available to meet contractual commitments, Western will have to purchase power at high prices and have no surplus power to sell at these high prices. Long term shifts in generation that results in Western increasing purchases and lost surplus sales could price Western's firm power out of the market and jeopardize repayment of the federal investment or force Western to reduce allocations and prompt construction of base load power plants (typically coal fired). Flows out of Gavin's Point of over 35,000 cfs requires spilling water resulting in no generation.		Generation amounts by month and compare to similar storage level at March 15th for current Master Manual. Quantity of power purchased and sold by month and compare to similar March 15 level storage for current Master Manual. Dollar amounts for purchased power and power sold, and compare to similar year for March 15 storage for current Master Manual. Track power prices, compare to normal (average?) year. Note any anomalies that might have affected prices. Footnote: The continuing drought could adversely impact the availability of supplemental or replacement power, perhaps causing a domino effect	Later peaks. Faster ramp up and downs to 35,000 cfs. Deem adverse impacts due to SR (not drought, not flood) non-reimbursable and be funded by Congressional appropriations

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Thermal				
Water quality effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise, when combined with high summer air temperatures, may affect the ability of downstream water users to meet NPDES permits for thermal discharges. Depending upon the frequency of occurrence, power plants may need to reduce generation levels, or consider alternatives such as cooling ponds or cooling towers in order to maintain compliance with NPDES permits.[1]	1) Additional costs ($) associated with replacement capacity and energy. 2) Additional costs ($) associated with supplemental or alternative cooling systems.		States will enforce NPDES permit conditions for thermal discharges. Renewed NPDES permits may need to be changed due to the change in flow regimes from Gavins Point Dam. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Thermal				
Water quality effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise, when combined with high summer air temperatures, may affect the ability of downstream water users to meet NPDES permits for thermal discharges. Depending upon the frequency of occurrence, power plants may need to reduce generation levels, or consider alternatives such as cooling ponds or cooling	1) Additional costs ($) associated with replacement capacity and energy. 2) Additional costs ($) associated with supplemental or alternative cooling systems.		States will enforce NPDES permit conditions for thermal discharges. Renewed NPDES permits may need to be changed due to the change in flow regimes from Gavins Point Dam. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
	towers in order to maintain compliance with NPDES permits.[1]			
Navigation	Spring rise releases which decrease reservoir levels potentially decrease navigation days/service levels, or worse case scenario, precluding navigation (1" of service level = 17 tons/barge). The decreased flows would directly impact efficiency of the middle Mississippi River. (Note: Total economic impact to upper MS/IL River $2.3 billion/yr). If flow is reduced below navigation service levels in April, navigation would be severely crippled, since historically 40% of ag business is in April/early May. 1 barge = 58 trucks/increases to air pollution. Terminal access could be limited/lost by flooding during "rise." Declining reservoir levels would long-term negatively impact water available for navigation. Man-made flooding degrades navigation channel.			

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Water Supply				
Water Supply effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise could result in increased maintenance costs related to additional amounts of sedimentation and trash being deposited in the intake structures of water supply facilities downstream from Gavins Point dam.[1]	1) Additional costs ($) associated with cleaning silt and other debris from water supply intake structures. 2) Additional costs ($) associated with modifications to intake structures to reduce sedimentation and trash build up.		Modifications to water supply intake structures may help to reduce the build up of sedimentation and trash. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Water Supply reservoirs	Loss of municipal water supply (especially tribal intakes) begins at the following elevations **Garrison** 1801.5 – Shutdown of Parshall **Oahe** 1564 – Shutdown Wakpala **Fort Peck ???**	Individual reservoir elevation vs. individual intake elevation	USACE database	Minimize reservoir declines, Extend intakes, alternative water supplies (expensive)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Water Quality				
Water quality effects of the alternatives on the Missouri River mainstem lakes.	Severe fluctuations in lake elevations in Fort Peck Lake, Lake Sakakawea, and Lake Oahe may affect the size and quality of coldwater fish habitat. Coldwater Garrison 800,000 acre ft impacts 200,000 acre ft likelihood of fish kill increases.	Acre feet	State Agencies Hydroacoustic Survey	As part of the Missouri River adaptive management process, the Corps, Tribes, States, and EPA should evaluate the relationship between coldwater habitat and water quality to lake elevations based upon reliable water quality monitoring data.
Irrigation	Start losing irrigation intakes at system storage levels of ~43 MAF	Develop database on irrigation intakes	Check data	Extend / Relocate Intakes. Not always feasible

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Recreation	The CWCP does not allow for water levels to be maintained during the critical period for fish production (April-June) in mainstem reservoirs under certain runoff scenarios. Spring rise proposals which increase the loss of water from mainstem reservoirs would exacerbate the impacts to reservoir fish populations. With regard to the spring rise and fluctuating reservoir levels -the first peak should end prior to April 7 and the second peak should begin late as possible, i.e. late May, June or even July. The interphase release levels should be kept as low as possible	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State fish & game agencies monitor fisheries in mainstem reservoirs.	Balance harms
Recreation	Loss of use & boat ramp access loss becomes an issue ~45 to 40 MAF	Maintain database	Check data	Extend / Relocate to the extent possible. Not possible in all instances.
Recreation	Oahe mid 90's $25 million/river Recent years $8-9 year. Similar losses to Lake Sakakawea and Fort Peck fishing industries	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State agencies monitor usage	???

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Agriculture	Lost Land, lost real estate/value	1.4 million acres in the Missouri River flood plain	Historical land value/affected land vs. non-affected land	Taxpayers pay
Agriculture	Crop damage/loss of income	Dollars/acre	Farm Service Agency	$/acre x total lost acres
Agriculture	Shipping costs barge vs. rail	Shipping Rate difference - Basis in winter (no barge traffic) vs basis during navigation season	Check prices during the year. Pro Exporter, FAPRI	???
Agriculture	Loss of Market/ Disruption to barge service resulting in less places to sell grain	Water compelled rates	New or historic studies	???
Agriculture	Land Loss / erosion	Count acres	Farm Service Agency	Taxpayers pay
Agriculture	Crop Insurance	Lower average yield/base for crop insurance due to more frequent flooding	FSA	New type of insurance to cover man-made floods

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Riparian	Bank Degradation/loss of land	Value/acres x lost acres	USDA, real estate values	Taxpayers pay
	A. For riparian landowners on the Ponca, NE-Yankton, SD reach of the Missouri, the principal (and much dreaded) impact would be the inevitable increase in the already severe erosion. Land lost is never restored as usable land. Exacerbating the prospect of increased losses is the fact that the "spring-rise" proposal is <u>intended</u> to erode the river's shorelines. USACE <u>stated aim</u> of the "spring-rise" proposal is to put more nutrients in the water for fish. B. Bottom-degradation is lowering the river bed and also the water table. Cottonwood forests, e.g., are not replacing themselves; head-cutting on the tributaries increases, intake structures etc., have to be lowered and bridges are endangered.	A. Do not increase the flows B. Bank stabilization (would not defeat one aim of the "spring-rise." C. Compensation ($$$) for the riparian owners for land losses, etc.	Land records. USDA has aerial photos/maps via which the exact amount of the loss can be determined	COMPENSATION (see measures)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	**1st Order Social/Economic Impacts (Positives**			
Fish Wildlife / Ecosystem	• Increase in fisheries • Increase in waterfowl, raptors, birds • Increase in riparian fauna • Habitat for pollinators and biocontrol agents • Preservation of genetic diversity	• Population viability • Age structure • Reproductive success • Indicator species • Habitat index for quality • Biodiversity from baseline	State, tribal and federal agencies develop monitoring plans for various biotic and abiotic parameters	None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Wildlife viewing opportunities and other recreational amenities	• State/local parks etc. visitor with satisfaction survey		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Overall cost-saving to the taxpayer less restoration efforts, T/E recovery efforts. • Reduced need for NRCS floodplain programs, wetland loss programs, and other mitigation requirements • Less $ for stocking restoration efforts	Data from state and federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• More habitat available in and adjacent to the floodplain • Improved contaminant sinks • Bio-transformation of excess nutrients	• Habitat surveys and/or indices • State/Federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	• Production clean water (more sustainable, natural system). • Protection of recharge areas and watersheds • Detention of potential floodwaters • Reduction of erosion and sedimentation shoreline stability—Les $ for stabilization • Production of topsoil • Improved resilience to external perturbation, therefore less need to perform follow-up maintenance	• Water Quality – turbidity, metals • Physical chemical parameters • Floodplain assessment in structure and function from over-time (improvement)		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
	2nd Order Social/Economic Impacts: (Positives)			
Fish Wildlife / Ecosystem	• Increased tourism • Increased $ from Recreational goods/services • More $ to communities • More opportunities to capture medicinal benefits of plant/animal populations • Less cost to taxpayer for restoration, maintenance, programs • Increased fish & game based recreation • Natural groundwater recharge	Sandbars used by hunters Fishing licenses (in-state/out-of-state) Chamber of Commerce data See NAP report 2002	Need an economic model or economist	

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Navigation	Spring rise releases which decrease reservoir levels potentially decrease navigation days/service levels, or worse case scenario, precluding navigation (1" of service level = 17 tons/barge). The decreased flows would directly impact efficiency of the middle Mississippi River. (Note: Total economic impact to upper MS/IL River $2.3 billion/yr). If flow is reduced below navigation service levels in April, navigation would be severely crippled, since historically 40% of ag business is in April/early May. 1 barge = 58 trucks/increases to air pollution. Terminal access could be limited/lost by flooding during "rise." Declining reservoir levels would long-term negatively impact water available for navigation. Man-made flooding degrades navigation channel.			
Historic, Cultural & Burial Grounds	Lowered reservoirs and fluctuating reservoirs put historic, cultural & burial sites at increased risks to erosion and looting.	Survey of sites	Survey and monitoring during low water periods	Protection and increased reservoir levels with less fluctuation.

Socio-Economic Technical Working Group Spring Rise Proposal

Draft of July 22, 2005

Title of Option: Modified Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21)

Note: Excluding fish and wildlife resource interests (an authorized use which would continue to be significantly compromised/impacted) and certain recreational users, the members of the Socio-Economic Technical Working Group (SETWG) expressed unanimous support for the recommendations contained in this report. (The strongest divergence of opinion centered on the desirability of a single or bimodal rise.)

1. Description of the Proposal:

Tables 1A and1B provide general rationale for the following:

a. Number of Rises:

Strong preference for 1 mode; however, the SETWG has noted its preferences regarding a second rise should it be required below.

b. Flood Control Targets/constraints:

Minimal to no adjustment.

c. Timing, duration, magnitude, rise and fall rates of First Rise:

- **Timing:** Start of the First Rise should begin soon enough so release levels coincide with minimum navigation service release levels from Gavins Point by March 23rd (rise should begin March 21- 22 and decline to flow-to-target minimum navigation service levels by April 7th)
- **Magnitude:** < 35 kcfs. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible

d. Timing, duration, magnitude of Flow Between Rises:

Minimum navigation service levels flow-to-target

e. Timing, duration, magnitude, rise and fall rates of Second Rise:

- **Timing:** Timing should be such that the initial 30% decline from the peak of the Second Rise should be completed as close as possible to May 21st.
- **Magnitude:** $\leq$52 kcfs. The critical component of magnitude is the length of time the peak is above the critical floodgate gate gage level (CFGGL, yet to be determined). Specifically, the peak above the CFGGL should be as short as possible, 1-3 days. Magnitude should be prorated based upon storage and the most up-to-date runoff predictions for areas above and below Sioux City. James River flows should count toward flow levels throughout the Spring Rise.
- **Rise:** As steep as possible
- **Fall:** As steep as possible down to the CFGGL. Duration and rate of fall are less critical once levels are below the CFGGL.

f. **How does this address water availability? Variation for wet, normal or dry years (including Stop Protocols or precludes):**

This rise is designed for dry conditions with regard to low mainstem storage levels and low runoff levels. By starting the rise later in May, storage is saved in upper basin reservoirs. Flow-to-target during May benefits system storage relative to the CWCP. Starting the second rise at flow-to-target levels will lessen the magnitude while still maintaining the delta (stage change). Mountain snowpack generally begins entering the system later in May allowing for timely replacement of storage in mainstem reservoirs. At the same time, by May 21, possibly earlier, agricultural interests down river face the inability to replant if the peak results in interior drainage problems.

Group should discuss stop protocols.

Flooding and/or a spring rise resulting in mainstem storage dropping to a level that threatens water intakes in the reservoirs (38 MAF)

g. **Volume of water used**:

Design incorporates socioeconomic recommendations into the Pallid Sturgeon Fish & Wildlife Proposal 1 7-21 (PAFW PROP 1 7-21). The SETWG will attempt to provide this calculation for presentation to the Plenary Group.

2. Hydrograph chart (with sideboards visually noted):

SETWG will attempt to have a hydrograph completed for presentation to the Plenary Group.

3. Anticipated effects

a. **Proposal's anticipated effects on, or benefits to, Pallid Sturgeon (how does it assist in flow, timing, temperature, photoperiod, compare with historic hydrograph, comparison with historic flow percentiles, etc):**

This proposal works off of recommendations from the Pallid Sturgeon Technical Working Group.

b. **Proposal's anticipated effects on, or benefits to, socio-economic factors (how does this Proposal appear to affect water used in the basin, how to flows attenuate, effect on reservoir levels, navigation impacts, what modeling helps understand the effects)**:

The group provides general observations regarding impacts in Table 2. A thorough accounting of impacts is necessary and will require formal study.

c. **Proposal's anticipated effects on, or benefits to, historic, cultural and burial sites (how does this Proposal appear to affect historic, cultural and burial sites in the basin, what modeling helps understand the effects):**

This proposal will minimize losses to mainstem system storage. In fact because the May peak will now more closely coincide with mountain snowpack runoff, mainstem system storage from the start to finish of the spring rise may realize little relative change.

4. Brief description of monitoring methods and indicators:

A monitoring regime that measures impacts of the Spring Rise to all socio-economic interests/uses should be in place prior to implementation. The SETWG lacked expertise to develop a list of indicators and strategies and therefore recommends that an expert and impartial third party is identified to develop a monitoring regime. An ad-hoc committee should be appointed to select this group. The SETWG believes that mitigation and/or compensation strategies that are closely tied to the results of monitoring efforts should be evaluated.

Table 1A, Socio-Economic Interests Regarding Certain Characteristics of a ***First*** 2006 Spring Rise

	DURATION	TIMING	QUANTITY	MODES	RATE OF RISE	RATE OF FALL	PRE-RISE DISCHARGE[1]	PRECLUDE[2]	PRORATE[3]	FLOOD[4] CONTROL CONSTRAINT
USE	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3		4	4	0
Hydro	S	L	1	1	3	3		4	4	0
Therm	S	L[5]	1	1	3	3		4	4	0
Nav	S	E	1	1	3	3		5	5	0
W Supp	S	L	1	1	3	3		4	4	NA
W Qual	S/L[6]	L	1/2/3[7]	1	3	3		3	4	NA
Irr	S	E	1	1	3	3		3	4	NA
Rec	S	L[8]	1	1	3	3		3	4	NA
Ag	S	E[9]	1	1	3	3		5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1		1	1	=

[1] Since system releases are at CWCP winter release levels prior to the first rise, pre-rise discharge is not an issue.
[2] These two terms are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.
[3] Spring Rise may be prorated based on system storage or runoff.
[4] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.
[5] July or August.
[6] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.
[7] Ibid.
[8] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.
[9] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period.

Table 1B, Socio-Economic Interests Regarding Certain Characteristics of a ***Second*** 2006 Spring Rise										
	DURATION	**TIMING**	**QUANTITY**	**MODES**	**RATE OF RISE**	**RATE OF FALL**	**PRE-RISE DISCHARGE**	**PRECLUDE** [10] [11] [12]	**PRORATE** [13]	**FLOOD[14] CONTROL CONSTRAINT**
USE	S/L Short/Long	E/L Early/Late	1/2/3 Sm/Med/Large	1/2 Single/Bi	1/2/3 Slow/Med/Fast	1/2/3 Slow/Med/Fast	1/2/3 11-18/18-25/25-35	1/2/3/4/5 ≤31/≤35/≤40/≤45/≤57	1/2/3/4 ≤31/≤35/≤40/≤45	=/</0 (0=no change)
FC	S	E	1	1	3	3	1	4	4	0
Hydro	S	L	1	1	3	3	1/2[15]	4	4	0
Therm	S	L[16]	1	1	3	3	1/2/3[17]	4	4	0
Nav	S	E	1	1	3	3	3[18]	5	5	0
W Supp	S	L	1	1	3	3	1/2[19]	4	4	NA
W Qual	S/L[20]	L	1/2/3[21]	1	3	3	1/2[22]	3	4	NA
Irr	S	E	1	1	3	3	1	3	4	NA
Rec	S	L[23]	1	1	3	3	1	3	4	NA
Ag	S	E[24]	1	1	3	3	1/2/3[25]	5	5	0
Riparian	S	E	1	1	3	1		3	3	0
Fish/Wild	S/L	Mimic natur	3 or mimic	2	2	1	1	1	1	=

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[10] Spring Rise may be precluded based on system storage or runoff. Responses were made on the basis of a water consumptive spring rise. If the spring rise added water to storage in mainstem reservoirs through the flexibility afforded by a low (i.e. winter release level) pre-rise discharge, then a preclude would not be requested.

[11] If the annual spring rise in Oahe reservoir falls below 1578' feet MSL elevation on March 15, 2006 and/or if projections show at any time an MSL elevation for Oahe at or below 1567' we recommend a preclude to a 'spring rise' release. Maintaining these elevations is absolutely critical in maintaining an adequate water supply for at least 14,000 people living on or near the Cheyenne River Sioux Tribe Indian Reservation in central South Dakota.

[12] Preclude and proration are often intertwined with storage levels. Many of the concerns with fluctuations in storage levels and a spring rise are intimately tied with runoff in a given year. Concerns about fish production in reservoirs may be completely eliminated if runoff is sufficient to provide both a spring rise and rising elevations in mainstem reservoirs. Conversely, during a low runoff year, the harms to fish production will be exacerbated with the addition of a spring rise. This has very little to do with mainstem storage levels (other than surface area of water) and everything to do with the amount of water (runoff), coming into the system.

[13] Spring Rise may be prorated based on system storage or runoff.

[14] Flood control constraint is raised to a level equal to the Spring Rise (=), is raised to a level less than the Spring Rise (<), or is not raised at all.

[15] Releases should be sufficient to meet normal hydropower demands. Winter releases, a period of high power demand, are around generally about 11 kcfs. Pre-rise discharge would be at a time of lower power demand, April-May. Therefore a 1 is likely warranted. Moreover, by increasing storage, head is increased above the turbines and more water is available for release during the summer, another period of high hydropower demand.

[16] July or August.

[17] Low releases during April-May would not impact thermal power production. It may be a positive as more water would be available during the summer when greater quantities are needed for cooling. If the Spring Rise is later than April, a 2 would be more appropriate. If the second rise is later than May, a 3 may be more appropriate.

[18] See xxvi

[19] Releases should be sufficient to meet water supply needs. Water supply needs are met at winter release levels for riverine intakes. Early season (April/May) releases could be similar to winter releases and still meet riverine water intake/supply needs. Additionally, increased storage would benefit reservoir based water intakes. Therefore a 1 is likely warranted.

[20] Increased storage improves water quality in reservoirs. Water quality in riverine stretches is maintained with sufficient flows.

[21] Ibid.

[22] Ibid.

[23] Gamefish interests would prefer that a Spring Rise occur outside of the April 7 – May 31 spawning period.

[24] By May 21. The rise must be done early enough so that is does not compound the natural rise occurring during this period. *Dave Sieck will further clarify as necessary.*

[25] A lower pre-rise discharge would increase flood protection to flood plain agriculture.– Spring rise releases which decrease reservoir levels potentially decrease navigation days/service levels, or worse case scenario, precluding navigation (1" of service level = 17 tons/barge). The decreased flows would directly impact efficiency of the middle Mississippi River. (Note: Total economic impact to upper MS/IL River $2.3 billion/yr). If flow is reduced below navigation service levels in April, navigation would be severely crippled, since historically 40% of ag business is in April/early May. 1 barge = 58 trucks/increases to air pollution. Terminal access could be limited/lost by flooding during "rise." Declining reservoir levels would long-term negatively impact water available for navigation. Man-made flooding degrades navigation channel.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Flood Control	FEMA Flood Insurance Program	Ruling from FEMA	National Weather Service/USACE	Policy Change / Pay no matter what
Flood Control	Internal Drainage	Pumping and/or Flood Insurance	Levee Board/USACE	Pay pumping costs and all crop loss
Flood Control	Bank Erosion above revetment	Rip-rap/rock is too low. It needs to be higher up the revetment	Levee Board/USACE	Replace revetment to project authorization
Flood Control	Levee overtop	Raise Levees	Levee Board/USACE	Policy change – pay for all floods including small floods. (or) Raise/Move levees (USACE pay)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Hydropower	Flow regime changes from Gavins Point Dam required to support a Spring Rise may result in a shift in Mainstem hydropower generation from periods of peak electrical demand to off-peak periods. Such shifts could result in increased costs to the Western Area Power Administration (WAPA) to supply their firm commitments, thereby increasing the costs to their customers.	Additional costs ($) associated with hydropower capacity and energy marketed by WAPA.		
Hydropower	Flow regime changes from Gavins Point Dam required to support a SR will result in a shift in mainstem hydropower generation from seasonal periods of high demand to seasonal periods of low demand. Shifting generation to low demand periods has two impacts. Generation surpluses to Western's contractual commitments is sold at very low prices. To the extent that less water is available to meet contractual commitments, Western will have to purchase power at high prices and have no surplus power to sell at these high prices. Long term shifts in generation that results in Western increasing purchases and lost surplus sales could price Western's firm power out of the market and jeopardize repayment of the federal investment or force Western to reduce allocations and prompt construction of base load power plants (typically coal fired). Flows out of Gavin's Point of over 35,000 cfs requires spilling water resulting in no generation.		Generation amounts by month and compare to similar storage level at March 15th for current Master Manual. Quantity of power purchased and sold by month and compare to similar March 15 level storage for current Master Manual. Dollar amounts for purchased power and power sold, and compare to similar year for March 15 storage for current Master Manual. Track power prices, compare to normal (average?) year. Note any anomalies that might have affected prices. Footnote: The continuing drought could adversely impact the availability of supplemental or replacement power, perhaps causing a domino effect	Later peaks. Faster ramp up and downs to 35,000 cfs. Deem adverse impacts due to SR (not drought, not flood) non-reimbursable and be funded by Congressional appropriations

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Thermal				
Water quality effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise, when combined with high summer air temperatures, may affect the ability of downstream water users to meet NPDES permits for thermal discharges. Depending upon the frequency of occurrence, power plants may need to reduce generation levels, or consider alternatives such as cooling ponds or cooling towers in order to maintain compliance with NPDES permits.[1]	1) Additional costs ($) associated with replacement capacity and energy. 2) Additional costs ($) associated with supplemental or alternative cooling systems.		States will enforce NPDES permit conditions for thermal discharges. Renewed NPDES permits may need to be changed due to the change in flow regimes from Gavins Point Dam. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Navigation				

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Water Supply				
Water Supply effects of the Spring Rise alternatives on the river segments of the Missouri River	Flow regime changes from Gavins Point Dam associated with a Spring Rise could result in increased maintenance costs related to additional amounts of sedimentation and trash being deposited in the intake structures of water supply facilities downstream from Gavins Point dam.[1]	1) Additional costs ($) associated with cleaning silt and other debris from water supply intake structures. 2) Additional costs ($) associated with modifications to intake structures to reduce sedimentation and trash build up.		Modifications to water supply intake structures may help to reduce the build up of sedimentation and trash. Including appropriate preclude or proration constraints for providing a Spring Rise could also help to mitigate potential impacts.
Water Supply reservoirs	Loss of municipal water supply begins at the following elevations **Garrison** 1801.5 – Shutdown of Parshall **Oahe** 1564 – Shutdown Wakpala **Fort Peck ???**	Individual reservoir elevation vs. individual intake elevation	USACE database	Minimize reservoir declines, Extend intakes, alternative water supplies (expensive)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Water Quality				
Water quality effects of the alternatives on the Missouri River mainstem lakes.	Severe fluctuations in lake elevations in Fort Peck Lake, Lake Sakakawea, and Lake Oahe may affect the size and quality of coldwater fish habitat. Coldwater Garrison 800,000 acre ft impacts 200,000 acre ft likelihood of fish kill increases.	Acre feet	State Agencies Hydroacoustic Survey	As part of the Missouri River adaptive management process, the Corps, Tribes, States, and EPA should evaluate the relationship between coldwater habitat and water quality to lake elevations based upon reliable water quality monitoring data.
Irrigation	Start losing irrigation intakes at system storage levels of ~43 MAF	Develop database on irrigation intakes	Check data	Extend / Relocate Intakes. Not always feasible

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Recreation	The CWCP does not allow for water levels to be maintained during the critical period for fish production (April-June) in mainstem reservoirs under certain runoff scenarios. Spring rise proposals which increase the loss of water from mainstem reservoirs would exacerbate the impacts to reservoir fish populations. With regard to the spring rise and fluctuating reservoir levels -the first peak should end prior to April 7 and the second peak should begin late as possible, i.e. late May, June or even July. The interphase release levels should be kept as low as possible	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State fish & game agencies monitor fisheries in mainstem reservoirs.	Balance harms
Recreation	Loss of use & boat ramp access loss becomes an issue ~45 to 40 MAF	Maintain database	Check data	Extend / Relocate to the extent possible. Not possible in all instances.
Recreation	Oahe mid 90's $25 million/river Recent years $8-9 year. Similar losses to Lake Sakakawea and Fort Peck fishing industries	Under runoff scenarios which would cause reservoirs to fall during the period April – May, adopt a spring rise plan which adds water to reservoirs during the pre-rise phase and/or the interphase between rises	State agencies monitor usage	???

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Agriculture	Lost Land, lost real estate/value	1.4 million acres in the Missouri River flood plain	Historical land value/affected land vs. non-affected land	Taxpayers pay
Agriculture	Crop damage/loss of income	Dollars/acre	Farm Service Agency	$/acre x total lost acres
Agriculture	Shipping costs barge vs. rail	Shipping Rate difference - Basis in winter (no barge traffic) vs basis during navigation season	Check prices during the year. Pro Exporter, FAPRI	???
Agriculture	Loss of Market/ Disruption to barge service resulting in less places to sell grain	Water compelled rates	New or historic studies	???
Agriculture	Land Loss / erosion	Count acres	Farm Service Agency	Taxpayers pay
Agriculture	Crop Insurance	Lower average yield/base for crop insurance due to more frequent flooding	FSA	New type of insurance to cover man-made floods

	Potential Impact	**Measure**	**Monitoring Mechanism**	**Mitigation**
Riparian	Bank Degradation/loss of land	Value/acres x lost acres	USDA, real estate values	Taxpayers pay
	A. For riparian landowners on the Ponca, NE-Yankton, SD reach of the Missouri, the principal (and much dreaded) impact would be the inevitable increase in the already severe erosion. Land lost is never restored as usable land. Exacerbating the prospect of increased losses is the fact that the "spring-rise" proposal is <u>intended</u> to erode the river's shorelines. USACE <u>stated aim</u> of the "spring-rise" proposal is to put more nutrients in the water for fish. B. Bottom-degradation is lowering the river bed and also the water table. Cottonwood forests, e.g., are not replacing themselves; head-cutting on the tributaries increases, intake structures etc., have to be lowered and bridges are endangered.	A. Do not increase the flows B. Bank stabilization (would not defeat one aim of the "spring-rise." C. Compensation ($$$) for the riparian owners for land losses, etc.	Land records. USDA has aerial photos/maps via which the exact amount of the loss can be determined	COMPENSATION (see measures)

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	**1st Order Social/Economic Impacts (Positives**			
Fish Wildlife / Ecosystem	• Increase in fisheries • Increase in waterfowl, raptors, birds • Increase in riparian fauna • Habitat for pollinators and biocontrol agents • Preservation of genetic diversity	• Population viability • Age structure • Reproductive success • Indicator species • Habitat index for quality • Biodiversity from baseline	State, tribal and federal agencies develop monitoring plans for various biotic and abiotic parameters	None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Wildlife viewing opportunities and other recreational amenities	• State/local parks etc. visitor with satisfaction survey		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• Overall cost-saving to the taxpayer less restoration efforts, T/E recovery efforts. • Reduced need for NRCS floodplain programs, wetland loss programs, and other mitigation requirements • Less $ for stocking restoration efforts	Data from state and federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
Fish Wildlife / Ecosystem	• More habitat available in and adjacent to the floodplain • Improved contaminant sinks • Bio-transformation of excess nutrients	• Habitat surveys and/or indices • State/Federal agencies		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows.

	Potential Impact	Measure	Monitoring Mechanism	Mitigation
Fish Wildlife / Ecosystem	• Production clean water (more sustainable, natural system). • Protection of recharge areas and watersheds • Detention of potential floodwaters • Reduction of erosion and sedimentation shoreline stability—Les $ for stabilization • Production of topsoil • Improved resilience to external perturbation, therefore less need to perform follow-up maintenance	• Water Quality – turbidity, metals • Physical chemical parameters • Floodplain assessment in structure and function from over-time (improvement)		None needed---overall tremendous realization of cost savings in the long-term to numerous natural resources and other service flows
	2nd Order Social/Economic Impacts: (Positives)			
Fish Wildlife / Ecosystem	• Increased tourism • Increased $ from Recreational goods/services • More $ to communities • More opportunities to capture medicinal benefits of plant/animal populations • Less cost to taxpayer for restoration, maintenance, programs • Increased fish & game based recreation • Natural groundwater recharge	Sandbars used by hunters Fishing licenses (in-state/out-of-state) Chamber of Commerce data See NAP report 2002	Need an economic model or economist	

Monitoring Plan
Sacred, Historical, Cultural and Burial Sites

Introduction:
Because all manipulation of lake levels can potentially expose vulnerable sacred, historical, cultural and burial sites, effective monitoring is a necessary part of avoiding and minimizing adverse effects on sacred, historical, and cultural sites and human burials. Two types of monitoring are required:

1. To carry out on-going shoreline monitoring to discourage and apprehend looters; and
2. To evaluate impacts on particularly sensitive and/or endangered sacred, historical, cultural and burial sites.

Recommendations:

1. General Site/Shoreline Monitoring. According to the Programmatic Agreement (PA):

   "**13. Site Monitoring Program**

   A) Site Monitoring. The Corps shall develop and implement a monitoring program to provide continued oversight of historic properties located on federal land managed by the Corps and to collect information on site conditions and effects or threats to them (including but not limited to, erosion, recreational, agricultural and other encroachment, and looting and vandalism). The Corps shall use this information to plan and implement law enforcement and other preventive or corrective management actions.

   B) Site Monitoring Plan. The Corps shall develop a Monitoring Plan to describe the conduct of the monitoring program. The Plan shall discuss the types and location of sites to be monitored, field methodology of monitoring and conditions recordation (including forms, data dictionary); data storage, retrieval and analysis; schedule; staffing and qualifications; and other details. The Corps shall produce a preliminary draft and then the Corps, Affected Tribes and THPOs, SHPOs, ACHP, and other consulting parties shall work together to develop a draft version of the Monitoring Plan, in accordance with stipulation 6. The Corps, in consultation with the Affected Tribes and THPOs, SHPOs, ACHP, and other consulting parties shall develop a final monitoring plan within 180 days of submission of comments on the draft Monitoring Plan. The Corps shall implement the final monitoring plan according to the schedule in the monitoring plan, CRMPs, and in response to recent information about potential threats to sites." (2004 Programmatic Agreement, p. 11)

2. Site-Specific Monitoring.
   a. The Corps should consult with affected Tribes to develop a plan for monitoring specific known sites that are particularly vulnerable to damage and/or exposure from wave action, changing lake levels, and other factors;
   b. In many cases, Tribes may propose to contract with the Corps to carry out the day-to-day activities of identifying and monitoring sites; and
   c. Adequate funding to carry out these plans must be projected and budgeted by the Corps in a timely manner.

HISTORICAL, CULTURAL AND BURIAL SITES

TECHNICAL WORKING GROUP

COMMENTS TO THE PLENARY GROUP

MISSOURI RIVER 2006 SPRING RISE

Disclaimer: This report is solely the product of the Historical, Cultural and Grave Sites Technical Working Group of the Missouri River 2006 Spring Rise Plenary Group. Nothing in this report may be construed to convey an official position of all affected Missouri River Tribes on this matter. Such positions can only be arrived at through government-to-government consultation.

SECTION I BACKGROUND

Given current drought conditions and lack of information available today, it is impossible to make a rational analysis of sacred, cultural and historic resource impacts of various spring rise proposals with any specificity. Therefore, we must recommend no 2006 Spring Rise. Because of current low water levels in the main stem dams, there may not be enough water in 2006 to implement the spring rise program without endangering municipal water intakes sacred, cultural and historic resources. It is also clear that as reservoir levels recede, impacts and cost associated with cultural and historic resources will increase exponentially. While additional research and surveying is necessary to specify exact impacts on specific sites, it is incontrovertible that any reduction in elevation beyond existing levels with expose and damage a large number of sites on the National Historic Registry and sites eligible for the Registry.

The proposed 2006 spring rise is a federal undertaking, which would trigger Corps responsibility to comply with:

- Treaties and the Federal responsibility;
- Number of Federal Laws;
- Executive Orders;
- Memoranda of Agreement; and
- The 2004 Programmatic Agreement with the United States Army Corps of Engineers,

all of these authorities address protection and preservation of historic, sacred, cultural, and natural resources. See Appendix A for a brief explanation of the key provisions of the law.

Rights to Missouri River water are part of the treaty rights of Native American Tribes that historically were or are along the river. These rights are judicially established by the United State Supreme Court in the Winters Doctrine of 1908. In assuming management responsibility and control of Missouri River water, the Corps has assumed and acknowledges a trust responsibility for Multiple Tribal resources. As the Corps itself recognizes, "**The Federal Indian trust responsibility is a legally enforceable fiduciary obligation, on the part of the United States, to protect tribal lands, assets, resources, and treaty rights, as well as a duty to carry out the mandates of Federal law with respect to American Indian and Alaskan Native tribes.** In several cases discussing the trust responsibility, the Supreme Court has used language suggesting that it entails legal duties, moral obligations, and the fulfillment of understandings and expectations that have arisen over the entire course of dealings with the United States and the Tribes."-<u>Northwestern Division Native American Program Desk Guide p. 3.</u>

The essence of a trust responsibility is that the tribal resources, must be manage for the benefit of the affected Tribes. The 2004 PA which was signed by many of the river tribes describes all laws, regulations, rules, executive orders, MOAs and protocols for which the Corps has compliance responsibility to protect sacred, cultural and historic resources whenever a proposed project or undertaking is being considered which has the potential to impact such resources. All of the protocols in the 2004 PA are predicated on the trust responsibility the CORPS has to the

Tribes on the Missouri River, a legal discussion of protocols which is included in appendix B in order to meet its trust responsibility to Tribes, the Corps must:

A. Comply with provisions outlined in the 2004 PA;
B. Ensure safe and easy access to the shoreline so as not to impede the continuity of ancient spiritual ceremonies, see appendix C for relevant provisions (Executive Order 13007 and American Indian Religious Freedom Act of 1978 (AIRFA);
C. Ensure access for socioeconomic uses of Missouri River; and
D. Plan for and provide adequate funding (including travel, consultation, and other needs) to ensure effective tribal participation in Missouri River restoration and recovery effort.

The protection of cultural and historic resources is a national issue. All cultural and historic resources, associated with the history of both tribal and non-tribal groups, require protection on all areas of the Missouri River, including the Missouri National Recreational River.

Fluctuating water levels in the reservoirs clearly have widespread and significant impacts to sacred, cultural and historic resources. See the preamble of the PA (appendix B) for critical information on the adverse effects such as, looting activities, degeneration of medicinal plants habitat, shoreline erosion, and water quality. As noted above, there is a distinct lack of useful data to make rational decisions about a spring rise. Further research, (Note: research parameters are determined through consultation pursuant to the 2004 PA), is clearly needed to accurately determined impacts to cultural and historic resources. This will be discussed in greater detail in section II, recommendations of this document.

SECTION II RECOMMENDATIONS

RECOMMENDATION 1: NO SPRING RISE FOR 2006.
Given current drought conditions and the lack of information available today, it is impossible to make a rational analysis of cultural and historic resource impacts of various Spring Rise proposals. Therefore, we must recommend no 2006 Spring Rise unless if there is sufficient precipitation to raise the reservoirs to acceptable levels that will be agreed upon by Indian Tribes, THPO's, SHPO's, and interested parties. If there is sufficient precipitation to maintain or increase existing water elevations on the Reservoirs, the Historical/Cultural and Burial Working Group can support a Spring Rise for 2006 with the following provisions:

- Full compliance with the 2004 PA and Trust responsibility to Affected Tribes, as discussed above. The Spring Rise is a Federal undertaking, which triggers pre-decisional consultation requirements with all affected Tribes in the PA.

- Stop protocols will be developed pursuant to existing Federal laws, such as NAGPRA which requires any projects to halt work in the event that a burial is exposed.

- Stop protocols developed both system-wide and by individual reservoirs, to protect municipal water intakes, for example a stop protocol for Lake Sakakawea would be 1816 MSL.

- No new exposures of submerged historic, cultural, and sacred resources. Looting (and attendant costs) increase exponentially with receding shorelines.

- Spring rise alternatives that have the least effect on reservoir pool levels are preferable for protection. Under increasing drought conditions, the amount of water released for a spring rise must be reduced accordingly.

RECOMMENDATION 2: Missouri National Recreation River (MNRR) provide a stage model based on cross section markers in the 39 mile and 59 mile stretches of the MNRR above and below Gavin's Point Dam.

- Will provide data on water levels at specific points on the river for various spring rise scenarios.

- Determine impacts to specific sacred, cultural, or historic sites.

RECOMMENDATION 3: Adequate monitoring, enforcement and in-situ protection of sacred, cultural and historic sites and human burials. Pursuant to the PA's consultation protocols, the affected tribes and other interested parties will develop a monitoring plan specific to a spring rise.

- Identify new, additional funding sources to implement this recommendation.

RECOMMENDATION 4: Site specific monitoring– The proposed spring rise may have adverse effects on specific locations that can be narrowly delineated. We suggest using aerial photographs taken before and after the spring rise to monitor the effects on these specific locations, for example:

- Extant sandbars in the MNRR should be monitored to determine the effect of the spring rise on the man-made sandbars. Future construction should be halted within the limits of the MNRR until it is determined whether the spring rise will damage the man-made sandbars or perhaps naturally create suitable habitat.

- The newly constructed Ft. Yates intake on the Standing Rock Sioux Reservation is directly downstream from a delta deposit. This deposit should be monitored to determine the effects of the spring rise. If the delta deposits are mobilized and endanger the intake, remedial steps will have to be taken.

RECOMMENDATION 5: Conduct new traditional cultural property and intensive archaeological surveys on all Omaha District Corps lands to create a useful database for rational analysis of impacts of a 2006 spring rise. Inventories should be conducted pursuant to 36 CFR Part 800. A Possible source of data for 2006 projections of reservoir elevations as this will determine effect of the spring rise. Include data from State, Federal sources, including THPO/SHPO, NPS and BIA.

RECOMMENDATION 6: Adverse effect to sacred, cultural and historic resources be avoided and/or mitigated through shoreline stabilization, the use of geo-textile fabric and other preservation methods prior to or caused by a spring rise.

RECOMMENDATION 7: A culturally based risk assessment must be conducted in consultation with affected Tribes and interested parties:

- To determine or assess risk and potential effects to sacred, cultural, historic, and human resources.

- This risk assessment must be developed in consultation, to include necessary funding needs, with affected Tribes and interested parties.

RECOMMENDATION 8: In order to develop rational, fact based analyses of impacts to sacred, cultural and historic resources, and to achieve consensus among affect Tribes, the work of the Historic/Burial working group should continue. This work would of course need to be adequately funded to ensure effective participation of all affected Tribes.

SECTION III – CLOSING STATEMENT

“Federal lands managed by the Corps (both within and outside reservation boundaries) include places that hold religious and cultural importance of the Tribes, and some of these places are crucial for the cultural identities of the Tribes and, as such, for the survival of the Tribes as distinct peoples. Some of these places contain the graves of ancestors and funerary objects, in which Federal law recognizes the right of lineal descendants and culturally affiliated Tribes to take custody in the event that they are removed from the Earth. The Tribes expect the Corps to treat these sacred and cultural significant places as subject to the Federal trust responsibility.”

2004 Programmatic Agreement with the
U.S. Army Corps of Engineers